

**A REPORT OF
RCRA FACILITY INVESTIGATION (RFI)
ACTIVITIES AT THE FORMER AMPHENOL SITE,
FRANKLIN, INDIANA**

Volume 1: Report Text, Figures, Tables and Sheets

Prepared for:

**FRANKLIN POWER PRODUCTS
400 FORSYTHE STREET
FRANKLIN, INDIANA 46131**

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Prepared by:

**WW ENGINEERING & SCIENCE, INC.
5010 STONE MILL ROAD
BLOOMINGTON, INDIANA 47408**

April 27, 1993

07026.00



WW Engineering & Science
A Summit Company

Chain of Custody Record

Analytical Services

COC No.

Nº 30082

WWES Proj. Mgr.		Project Name										No's Correspond to Bottle Packing List	Container Type	For Lab Use Only				
WWES Proj. No.		Sampler (Print)												Rack/Tray No:				
		Sampler Signature												Lab Project #				
Date Sampled	Time Sampled	Matrix*	Composite	Grab	Sample Identification										No. of Containers	Analysis Required/Comments	Sample No.	Filtered Date/Time
21 May 93	1155	WTR	X		F	C	R	-	G	W	-	P	G	P	4	(2) 40 vOA - VOC 485, 486 (1) 1000 Pdry No. Oil - Tot. Am. CN' 487 (1) 1000 Pdry No. Oil - Tot. Am. CN' 488		
	1240	WTR			F	C	R	-	G	W	-	P	G	P	4	Same 487, 490 191 192		
	1500				F	C	R	-	G	W	-	P	G	P	4	Same 493, 494 495 496		
	1500				F	C	R	-	G	W	-	P	G	P	4	Same 497, 498 499 500		
	1620				F	C	R	-	G	W	-	P	G	P	4	Same 501, 502 503 504		
21 May 93					F	C	R	-	G	W	-	P	G	P	2	(2) 40 vOA - VOC 505, 506		

* Matrix: Water (WTR), Wastewater (WW), Soil (SOIL), Sludge (SLG), Air, Oil, Waste (WASTE)



HMM Associates, Inc.

A Summit Company

6908-302/HAZ/13862I

July 2, 1993

Mr. James H. Keith
WW Engineering & Science, Inc.
5010 Stone Mill Road
Bloomington, IN 47408

RE: Franklin-Curtis RFI
Inorganic Data Validation Report
Southwest Laboratory of Oklahoma
Metals: 5 low concentration samples
Cyanide: 5 low concentration samples

Dear Mr. Keith:

Data validation was performed on the inorganic analytical data from 5 low level water samples collected by WW Engineering & Science, Inc. (WWES) at the Franklin-Curtis site. The data were evaluated based on the following parameters according to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses, February 1989:

- data completeness
- holding times
- calibration verification
- field and laboratory blank results
- ICP interference check sample results
- matrix spike percent recovery results
- laboratory and field duplicate results
- laboratory control sample results
- ICP serial dilution analysis
- sample results
- All criteria was met for this parameter.

Data Completeness

The packages were complete and legible.

Holding Times

All holding times were met for all analytes.

Calibration Verification

All calibration results were reviewed and found to be acceptable.

Field and Laboratory Blanks

The method blanks were prepared and analyzed at the required frequency. The initial and continuing calibration blanks were also reported. There was one field blank, PGP-GW-13-04EB, included in the data package.

The continuing calibration blank (CCB) had a reported concentrations of 81.1 ug/L for aluminum, 6 ug/L for iron, and 420.5 ug/L for sodium. The preparation blank had reported concentrations of 58.2 ug/L for iron and 424.2 ug/L for sodium. The action level for these analytes is five times the reported concentration. Samples with reported concentrations less than five times the blank result will be treated as non-detects and qualified U.

The following analytes were detected in field blanks:

Calcium	914 ug/L
Chromium	38 ug/L
Iron	1350 ug/L
Lead	1.5 ug/L
Manganese	11.6 ug/L
Sodium	3720 ug/L
Zinc	41.7 ug/L

Sample results less than five times the reported result for the above analytes will be qualified U and treated as non-detects.

ICP Interference Check Sample Results

The reported results for the ICP interference check sample A were acceptable.

Mr. James Keith

July 2, 1993

Page 3

Matrix Spike Recovery Results

Matrix spike recovery results were not provided with the data package.

Laboratory and Field Duplicates

There were no laboratory duplicates submitted with the data package.

Aluminum, calcium, potassium, sodium, and zinc did not meet required criteria for field duplicates.

Positive sample results for aluminum, calcium, potassium, and zinc will be estimated (J).

Laboratory Control Sample Results

The laboratory control sample results were reviewed and found to be acceptable.

ICP Serial Dilution Analysis

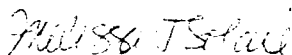
The following compounds did not meet the required criteria for serial dilution: aluminum, copper, nickel, and sodium. Positive results for sodium in all samples will be estimated (J). Positive results for aluminum, copper, and nickel will be estimated in sample FCR-PGP-GW-14-04.

Sample Results

All sample results were reported accurately by the laboratory.

Data tables for both the validated (qualified) and unvalidated analytical results have been provided. Please feel free to call me or Cosmo Gallinaro directly at (508) 371-4000 with questions.

Sincerely,



Melissa J. Solari
Data Reviewer



Cosmo Gallinaro
Project Manager

EPA Sample No.	PGP004	PGP120	PGP13D	PGP130	PGP140
Lab Sample No.	1386201	1386202	1386204	1386203	1386205
Matrix	Water	Water	Water	Water	Water
Level	Low	Low	Low	Low	Low
Date Collected	5/21/93	5/21/93	5/21/93	5/21/93	5/21/93
Date Received:	5/21/93	5/21/93	5/21/93	5/21/93	5/21/93
Units	ug/L	ug/L	ug/L	ug/L	ug/L
Analyte					
Aluminum	69.7 U	2660 J	595 J	330 U	2750 J
Antimony	23.0 U	23.0 U	23.0 U	23.0 U	23.0 U
Arsenic	2.0 U	6.1 B	2.0 U	2.0 U	3.6 B
Barium	7.0 U	918	67.9 B	79.2 B	125 B
Beryllium	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Cadmium	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
Calcium	914 J	493000 J	149000 J	197000 J	213000 J
Chromium	7.6 J	23.7 U	6.7 U	7.2 U	28.5 U
Cobalt	6.0 U	7.6 B	6.0 U	9.5 B	6.0 U
Copper	6.0 U	31.2	10.4 B	9.7 B	35.1 J
Iron	1350	15800	2350 U	2850 U	8710
Lead	1.5 J	19.8	3.5 U	2.7 U	16.9
Magnesium	171 U	64900	44400	26100	71400
Manganese	11.6 B	1740	180 U	754	1350
Mercury	0.2 U	0.20 U	0.2 U	0.2 U	0.2 U
Nickel	7.0 U	31.4 B	7.0 U	20.9 B	37.5 J
Potassium	248 U	6020 J	2060.0 J	1540 J	1820 J
Selenium	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Silver	7.0 U	7.0 U	7.0 U	7.0 U	7.0 U
Sodium	3720 B	15200 U	27900 J	16800 U	17800 U
Thallium	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Vanadium	5.0 U	8.4 B	5.0 U	5.0 U	6.8 B
Zinc	41.7	160 U	63.0 U	377 J	181 U
Cyanide	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U

Notes:

B = The reported value is less than the CRDL, but greater than or equal to the IDL.

J = The reported value is an estimated quantity.

U = The analyte was analyzed for, but not detected.

ug/L = micrograms per liter

REGION I
Data Review Worksheets

Site Name FRANKLIN COATS RFI
Reference Number _____

REGION I REVIEW OF INORGANIC
CONTRACT LABORATORY DATA PACKAGE

SOUTHWEST LABORATORY

The hardcopied (laboratory name) OF OLLAHAMA data package received at Region I has been reviewed and the quality assurance and performance data summarized. The data review included:

Case No.	<u>13062</u>	SAS No.		Sampling Date(s)	<u>5/21/93</u>
SDG. No.		Matrix	<u>WATER</u>	Shipping Date(s)	<u>5/21/93</u>
No. of Samples	<u>5</u>			Date Rec'd by Lab	<u>5/21/93</u>

Traffic Report Nos: PGP004, PGP120, PGP130

Trip Blank No.: _____

Equipment Blank No.: PGP004ES

Field Dup Nos: PGP13P

SOW No. 3/90 requires that specific analytical work be done and that associated reports be provided by the laboratory to the Regions, EMSL-LV, and SMO. The general criteria used to determine the performance were based on an examination of:

- | | |
|---------------------------------|------------------------------|
| -Data Completeness | -Field Duplicates |
| -Holding Times | -Lab Control Sample Results |
| -Calibrations | -Furnace AA Results |
| -Blanks | -ICP Serial Dilution Results |
| -ICP Interference Check Results | -Detection Limit Results |
| -Matrix Spike Recoveries | -Sample Quantitation |
| -Laboratory Duplicates | |

Overall Comments: _____

Definitions and Qualifiers:

- A - Acceptable data.
- J - Approximate data due to quality control criteria.
- R - Reject data due to quality control criteria.
- U - Analyte not detected.

Reviewer: Melissa Galai

Date: 7/8/93

REGION I
Data Review Worksheets

I. DATA COMPLETENESS - ALL INFORMATION WAS PROVIDED BY THE LAB.

MISSING INFORMATION

DATE LAB CONTACTED

DATE REC'D

Data Review Worksheets - ALL OK

Complete table for all samples and circle the analysis date for samples not within criteria.

METALS - 180 DAYS FROM SAMPLE COLLECTION
MERCURY - 28 DAYS FROM SAMPLE COLLECTION
CYANIDE - 14 DAYS FROM SAMPLE COLLECTION

1. If holding times are exceeded all positive results are estimated (J) and non-detects are estimated (UJ).
2. If holding times are grossly exceeded, the reviewer may determine that non-detects are unusable (R).

REGION I
Data Review worksheets

III A. INSTRUMENT CALIBRATION (Section 1) - ALL OK

1. Recovery Criteria

List the analytes which did not meet the percent recovery (%R) criteria for Initial or Continuing Calibration.

DATE	ICV/CCV%	ANALYTE	%R	ACTION	SAMPLES AFFECTED
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

ACTIONS:

If any analyte does not meet the %R criteria follow the actions stated below:

For Positive Results:

	Accept	Estimate (J)	Reject (R)
Metals	90-110%R	75-89%R, 111-125%R	<75%R, >125%R
Mercury	80-120%R	65-79%R, 121-135%R	<65%R, >135%R
Cyanide	85-115%R	70-84%R, 116-130%R	<70%R, >130%R

For Non-detected Results:

	Accept	Estimate (UJ)	Reject (R)
Metals	90-125%R	75-89%R	<75%R, >125%R
Mercury	80-135%R	65-79%R	<65%R, >135%R
Cyanide	85-130%R	70-84%R	<70%R, >130%R

REGION I
Data Review Worksheets

III B. INSTRUMENT CALIBRATION (Section 2)

2. Analytical Sequence

- A. Did the laboratory use the proper number of standards for calibration as described in the SOW? ☒ Yes or No
- B. Were calibrations performed at the beginning of each analysis? ☒ Yes or No
- C. Were calibration standards analyzed at the beginning of sample analysis and at a minimum frequency of ten percent or every two hours during analysis, whichever is more frequent? ☒ Yes or No
- D. Were the correlation coefficients for the calibration curves for AA, Hg, and CN ≥ 0.995 ? ☒ Yes or No
- E. Was a standard at 2xCRDL analyzed for all ICP analyses? ☒ Yes or No

If No,

The data may be affected. Use professional judgement to determine the severity of the effect and qualify the data accordingly. Discuss any actions below and list the samples affected.

REGION 1
Data Review Worksheet

IV A. BLANK ANALYSIS RESULTS (Sections 1-3)

List the blank contamination in Sections 1 & 2 below. A separate worksheet should be used for soil and water blanks.

1. Laboratory Blanks

MATRIX: WATER

DATE	ICB/CCB#	PREP BL	ANALYTE	CONC./UNITS
CCB#	<u>CCB#2</u>		<u>Na</u>	<u>420.5 ug/L</u>
	<u>CCB#2</u>		<u>AL</u>	<u>60.0 ug/L</u>
	<u>CCB#3</u>		<u>Na</u>	<u>343.0 ug/L</u>
		<u>PB#1</u>	<u>AL</u>	<u>58.22 ug/L</u>
		<u>PB#1</u>	<u>Na</u>	<u>424.16 ug/L</u>
	<u>CCB#4</u>		<u>FE</u>	<u>81.1 ug/L</u>
	<u>CCB#4</u>		<u>FE</u>	<u>6 ug/L</u>
	<u>CCB#4</u>		<u>Na</u>	<u>391.0 ug/L</u>

2. Equipment/Trip Blanks

DATE	EQUIP BL#	ANALYTE	CONC./UNITS (ug/L)
	<u>PBP-004EB</u>	<u>Ca</u>	<u>914</u>
		<u>Cr</u>	<u>30</u>
		<u>Fe</u>	<u>1350</u>
		<u>Pb</u>	<u>11.5</u>
		<u>Mn</u>	<u>11.6</u>
		<u>Na</u>	<u>3720</u>
		<u>Zn</u>	<u>41.7</u>

3. Frequency Requirements

A. Was a preparation blank analyzed for each matrix, for every 20 samples and for each digestion batch?

Yes or No

B. Was a calibration blank run every 10 samples or every 2 hours whichever is more frequent?

Yes or No

If No,

The data may be affected. Use professional judgement to determine the severity of the effect and qualify the data accordingly. Discuss any actions below, and list the samples affected.

REGION I
Data Review Worksheets

IV B. BLANK ANALYSIS RESULTS (Section 4)

4. Blank Actions

The Action Levels for any analyte is equal to five times the highest concentration of that element's contamination in any blank. The action level for samples which have been concentrated or diluted should be multiplied by the concentration/dilution factor. No positive sample result should be reported unless the concentration of the analyte in the sample exceeds the Action Level (AL). Specific actions are as follows:

1. When the concentration is greater than the IDL, but less than the Action Level, report the sample concentration detected with a U.
2. When the sample concentration is greater than the Action Level, report the sample concentration unqualified.

MATRIX: WATER

ELEMENT	MAX. CONC./ UNITS	AL/ UNITS
AL	81.1 ug/L	
Ca	914 ug/L	
Cr	38 ug/L	
Fe	1350 ug/L	
Pb	1.5 ug/L	
Mn	11.6 ug/L	
Na	3720 ug/L	

MATRIX: Water

ELEMENT	MAX. CONC./ UNITS	AL/ UNITS
Zn	41.7 ug/L	

NOTE: Blanks analyzed during a soil case must be converted to mg/kg in order to compare them with the sample results.

Conc. in ug/L X $\frac{\text{Volume diluted to (200ml)}}{\text{Weight digested (1gram)}}$ X $\frac{1L}{1000ml}$ X $\frac{1000gm}{1kg}$ X $\frac{1mg}{1000ug}$ = mg/kg

Multiplying this result by 5 to arrive at the action level gives a final result in mg/kg which can then be compared to sample results.

REGION I
Data Review Worksheets

V A. ICP INTERFERENCE CHECK SAMPLE (Sections 1 & 2)-ALL OK

1. Recovery Criteria

List any elements in the ICS AB solution which did not meet the criteria for %R.

DATE	ELEMENT	%R	ACTION	SAMPLES AFFECTED
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

ACTIONS:

If an element does not meet the %R criteria, follow the actions stated below:

	<u>PERCENT RECOVERY</u>		
	<50%	50-79%	>120%
Positive Sample Results	R	J	J
Non-detected Sample Results	R	UJ	A

2. Frequency Requirements

Were Interference QC samples run at the beginning and end of each sample analysis run or a minimum of twice per 8 hour working shift, whichever is more frequent?

Yes or No

If no,

The data may be affected. Use professional judgement to determine the severity of the effect and qualify the data accordingly. Discuss any actions below and list the samples affected.

REGION I
Data Review Worksheets

V B. ICP INTERFERENCE CHECK SAMPLE (Section 3) - ALL OK

3. Report the concentration of any elements detected in the ICS A solution > 2xIDL that should not be present.

ELEMENT	CONC. DETECTED IN THE ICS	CONC. OF INTERFERENTS IN THE ICS			
		AL	CA	FE	Mg
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

Estimate the concentration produced by the interfering element in all affected samples. See guidelines for examples. List the samples affected by interferences below:

SAMPLE AFFECTED	ELEMENT AFFECTED	SAMPLE CONC. (ug/L)	SAMPLE INTERFERENT CONC.				ESTIMATED INTERF. (ug/L)
			AL	CA	FE	Mg	
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____

ACTIONS:

1. In general, the sample data can be accepted without qualification if the sample concentrations of Al, Ca, Fe, and Mg are less than 50% of their respective levels in the ICS solution.
2. Estimate (J) positive results for affected elements for samples with levels of interferents 50% or more of that in the ICS solution.
3. Reject (R) positive results if the reported concentration is due entirely to the interfering element.
4. Estimate (UJ) non-detected results for which false negatives are suspect.

Give explanations for any actions taken below:

REGION I
Data Review Worksheets

VI. MATRIX SPIKE - ML OK

TR : LCS *

MATRIX: WATER

1. Recovery Criteria

List the percent recoveries for analytes which did not meet the required criteria.

S - amount of spike added
SSR - spikes sample result
SR - sample result

Analyte	SSR	SR	S	%R	Action

Matrix Spike Actions apply to all samples of the same matrix.

ACTIONS:

- If the sample concentration exceeds the spike concentration by a factor of 4 or more, no action is taken.
- If any analyte does not meet the %R criteria follow the actions stated below:

	PERCENT RECOVERY		
	<30%	30%-74%	>125%
Positive Sample Results	J	J	J
Non-detected Results	R	UJ	A

2. Frequency Criteria

- Was a matrix spike prepared at the required frequency? (Yes or No)
- Was a post digestion spike analyzed for elements that did not meet required criteria for matrix spike recovery? (Yes or No)

A separate worksheet should be used for each matrix spike pair.

* AN LCS WAS SUBSTITUTED FOR THE MS/MSD PAIR.

REGION I
Data Review Worksheets

VII. LABORATORY DUPLICATES - NOT APPLICABLE

List the concentrations of any analyte not meeting the criteria for duplicate precision. For soil duplicates, calculate the CRDL in mg/kg using the sample weight, volume and percent solids data for the sample. Indicate what criteria was used to evaluate precision by circling either the RPD or CRDL for each element.

MATRIX: _____

Element	CRDL		Sample #	Duplicate#	RPD	Action
	water ug/L	soil mg/kg				
Aluminum	200					
Antimony	60					
Arsenic	10					
Barium	200					
Beryllium	5					
Cadmium	5					
Calcium	5000					
Chromium	10					
Cobalt	50					
Copper	25					
Iron	100					
Lead	5					
Magnesium	5000					
Manganese	15					
Mercury	0.2					
Nickel	40					
Potassium	5000					
Selenium	5					
Silver	10					
Sodium	5000					
Thallium	10					
Vanadium	50					
Zinc	20					
Cyanide	10					

Laboratory Duplicate Actions should be applied to all other samples of the same matrix type.

ACTIONS:

1. Estimate (J) positive results for elements which have an RPD >20% for waters and >35% for soils.
2. If sample results are less than 5x the CRDL, estimate (J) positive results for elements whose absolute difference is >CRDL, (2xCRDL for soils). If both samples are non-detected, the RPD is not calculated (NC).

REGION I
Data Review Worksheets

VIII. FIELD DUPLICATES

List the concentrations of all analytes in the field duplicate pair. For soil duplicates, calculate the CRDL in mg/kg using the sample weight, volume and percent solids data for the sample. Indicate what criteria was used to evaluate the precision by circling either the RPD or CRDL for each element.

MATRIX: WATER

Element	CRDL		Sample #	Duplicate#	RPD	Action
	water	soil				
	ug/L	mg/kg	PGP130	PGP130		
Aluminum	200		595	330	57	J POS RESULTS
Antimony	60					
Arsenic	10					
Barium	200		67.9	79.2	15	
Beryllium	5					
Cadmium	5		149			
Calcium	5000		149000	147000	27	J POS RESULTS
Chromium	10		4.7	7.2	7	
Cobalt	50		6.0	9.53	NC	
Copper	25		10.4	9.7	7	
Iron	100		2350	2650	19	
Lead	5		3.5	2.7	25	
Magnesium	5000		44400	26100	50	NO ACTION
Manganese	15		180	757	122	NO ACTION
Mercury	0.2		9.0	20.93		
Nickel	40		2000 70	1510 2045	NC	
Potassium	5000		2060	1540	29	J POS RESULTS
Selenium	5					
Silver	10					
Sodium	5000		27900	46300	49	NO ACTION
Thallium	10					
Vanadium	50					
Zinc	20		63	377	142	J POS RESULTS
Cyanide	10					

Field Duplicate Actions should be applied to all other samples of the same matrix type.

ACTIONS:

1. Estimate (J) positive results for elements which have an RPD >30% for waters and >50% for soils.
2. If sample results are less than 5x the CRDL, estimate (J) positive results and ~~(NI) nondetected results~~ for elements whose absolute difference is >2xCRDL, (4xCRDL for soils). If both samples are non-detected, the RPD is not calculated (NC).

REGION I
Data Review Worksheets

IX. LABORATORY CONTROL SAMPLE - ALOK

1. Aqueous LCS

List any LCS recoveries not within the 80-120% criteria and the samples affected.

<u>DATE</u>	<u>ELEMENT</u>	<u>IR</u>	<u>ACTION</u>	<u>SAMPLES AFFECTED</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

2. Solid LCS

List any analytes that were not within the control windows set by the EPA for the solid LCS sample. The 80-120% criteria is not used to evaluate solid LCS results.

<u>ELEMENT</u>	<u>LCS CONC.</u>	<u>CONTROL WINDOWS</u>	<u>ACTION</u>	<u>SAMPLES AFFECTED</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

ACTIONS:

	<u>Percent Recovery</u>		
<u>AQUEOUS LCS</u>	<u><50%</u>	<u>51-79%</u>	<u>>120%</u>
Positive Results	R	J	J
Non-detected Results	R	UJ	A
<u>SOLID LCS</u>	<u><EPA Control Windows</u>		<u>>EPA Control Windows</u>
Positive Results	J		J
Non-detected Results	UJ		A

3. Frequency Criteria

- A. Was an LCS analyzed for every matrix, every digestion batch, and every 20 samples?

Yes or No

REGION I
Data Review Worksheets

X A. FURNACE ATOMIC ABSORPTION ANALYSIS

1. Duplicate Precision

-----X----- Duplicate injections and one-point analytical spikes were performed for all samples: duplicate injections agreed within $\pm 20\%$.

----- Duplicate injections and/or spikes were not performed for the following samples/elements: _____

----- Duplicate injections did not agree within $\pm 20\%$ for samples/elements: _____

2. Post Digestion Spike Recoveries

-----X----- Spike recoveries met the 85-115% recovery criteria for all samples.

----- Spike recoveries did not meet the 85-115% criteria but did not require MSA for the following samples/elements: _____

----- MSA was used to quantitate analytical results when contractually required.

_____ Correlation coefficients ≥ 0.995 , accept results.
_____ Correlation coefficients < 0.995 for sample numbers/elements: _____

----- Method of Standard Addition (MSA) was not performed as required for samples/elements: _____

ACTIONS:

1. Estimate (J) positive results if duplicate injections are outside $\pm 20\%$ RSD or CV.
2. If the sample absorbance is $< 50\%$ of post digestion spike absorbance the following actions should be applied:

		PERCENT RECOVERY		
		<u>$< 10\%$</u>	<u>11%-84%</u>	<u>$> 115\%$</u>
Positive Sample Results	J or R	J	J	J
Non-detected Results	R	UJ		A

3. Estimate (J) sample results if MSA was required and not performed.
4. Estimate (J) sample results if correlation coefficient was < 0.995 .

REGION I
Data Review Worksheets

XI. INDUCTIVELY COUPLED PLASMA (ICP) SERIAL DILUTION ANALYSIS

Serial Dilutions were performed for each matrix and results of the diluted sample analysis agreed within ten percent of the original undiluted analysis.

Serial Dilutions were not performed for the following:

X

Serial Dilutions were performed, but analytical results did not agree within 10% for analyte concentrations greater than 50x the IDL before dilution.

Report all results below that do not meet the required laboratory criteria for ICP serial dilution analysis.

MATRIX: WATER

ELEMENT	IDL	50XIDL	SAMPLE RESULT	SERIAL DILUTION	%D	ACTION
Aluminum	44	2200			17.6%	J Positive Result
Barium						
Beryllium						
Cadmium						
Calcium						
Chromium						
Cobalt	4	200				
Copper	4	200			29%	J Positive Result
Iron						
Lead						
Magnesium						
Manganese						
Nickel	7	350			23%	J Positive Result
Potassium						
Silver						
Sodium	210	10500			11%	J Positive Result
Vanadium						
Zinc						

Actions apply to all samples of the same matrix.

ACTIONS:

1. Estimate (J) positive results if %D > 15.

REGION I

Data Review Worksheets

XII. DETECTION LIMIT RESULTS

1. Instrument Detection Limits

X Instrument Detection Limit results were present and found to be less than the Contract Required Detection Limits.

 IDLs were not included in the data package on Form XI.

_____ IDLs were present, but the criteria was not met for the following elements: _____

2. Reporting Requirements

Were sample results on Form I reported down to the IDL not the CRDL for all analytes?

Yes or No

Were sample results that were analyzed by ICP for Se, Tl, As, or Pb at least 5x IDL.

Yes or No

Were sample weights, volumes, and dilutions taken into account when reporting detection limits on Form I.

(Yes or No

If No,

The reported results may be inaccurate. Make the necessary changes on the data summary tables and request that the laboratory resubmit the corrected data.

REGION I
Data Review Worksheets

XIII. SAMPLE QUANTITATION

X Sample results fall within the linear range for ICP and within the calibrated range for all other parameters.

_____ Sample results were beyond the linear range/ calibration range of the instrument for the following samples/elements:

In the space below, please show a minimum of one sample calculation per method:

ICP

ALL DATA WAS IN UG/L AND WAS CORRECTLY TRANSFERRED TO THE FORM I'S FOR ALL ANALYSES.

FURNACE

MERCURY

CYANIDE

For soil samples, the following equation may be necessary to convert raw data values (usually reported in ug/L) to actual sample concentrations (mg/kg):

The lab is required to use 1 gram sample (wet weight) to 200 ml.

Wet weight concentration =

$$\text{digest conc. in } \frac{\text{ug}}{\text{L}} \times \frac{200\text{ml}}{1\text{ gm}} \times \frac{1\text{L}}{1000\text{ ml}} \times \frac{1000\text{ug}}{1\text{kg}} \times \frac{1\text{mg}}{1000\text{ug}} = \frac{\text{mg}}{\text{kg}}$$

In addition the sample results are converted to dry weight using the percent solids calculations:

$$\frac{\text{Wet weight conc.}}{\% \text{solids}} \times 100 = \text{final concentration, dry weight (mg/kg)}$$



6908-302/HAZ/13862O

July 2, 1993

Mr. James Keith
WW Engineering & Science, Inc.
5010 Stone Mill Road
Bloomington, IN 47408

RE: Franklin-Curtis RFI
Organic Data Validation Report
Southwest Laboratory of Oklahoma
VOCs: 6 low concentration samples

Dear Mr. Keith:

Data validation was performed on the organic analytical data from 6 low level water samples collected by WW Engineering & Science, Inc. (WWES) at the Franklin-Curtis site. The data were evaluated based on the following parameters according to the Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses, February 1988:

- data completeness
- holding times
- GC/MS tuning
- calibration
- laboratory, field, and trip blanks
- surrogate spike recoveries
- matrix spike/matrix spike duplicates
- field duplicates
- internal standard performance
- sample quantitation
- All criteria was met for this parameter

Data Completeness

The data package was complete and legible.

Holding Times

All criteria was met for this parameter. Samples were analyzed within four days of collection.

GC/MS Tuning

All reported bromofluorobenzene (BFB) tunes met the required criteria.

Calibrations

The volatile calibration summaries were reviewed, and all calibration check compound (CCC) and system performance check compound (SPCC) requirements were met. Chloromethane had a percent relative standard deviation (%RSD) of 32.6 in the water initial calibration on 5/24/93, which is greater than the requirement of less than 30%. 2-Hexanone had a %RSD of 32.9 in the initial on 5/24/93. All criteria was met for the initial calibration on 4/19/93. All criteria was met for the continuing calibrations on 5/24/93 and 5/25/93. No action was taken as there were no positive results for either compound in the samples.

Blanks

The laboratory analyzed two method blanks, VBLK1 and VBLK 2. There were no compounds detected in either blank, no action on the data.

There was one equipment blank collected at the site, PGP004EB. This blank had reported concentrations of 4 ug/L of chloroform and 2 ug/L of toluene. One trip blank, PGP-GW-04TB, was also submitted and contained 1 ug/L of chloroform. These compounds were not detected in any associated samples and therefore has no effect on the data.

Surrogate Spike Recoveries

Surrogate spike recoveries for chloromethane were 176.89%, which is outside of the required window of 72%-163%. It was not detected in any samples and, therefore, no action is taken. All other compounds met the required criteria.

Matrix Spike/Matrix Spike Duplicate

A MS/MSD sample was not submitted to the laboratory, therefore, laboratory control samples were analyzed. All volatile laboratory control samples were found to be acceptable.

Mr. James Keith
July 2, 1993
Page 3

Field Duplicates

One field duplicate, FCR-PGP13-04D, was collected. The RPDs were reviews and found to be acceptable, however, the detection of acetone in sample FCR-PGP13-04 is most likely the result of lab contamination.

Internal Standard Performance

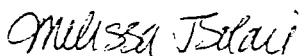
The internal standard performance was acceptable in the volatile analyses.

Sample Quantitation

The reported sample results were reviewed and found to be reported accurately.

Data tables for both the validated (qualified) and unvalidated analytical results have been provided. Please feel free to call me or Cosmo Gallinaro directly at (508) 371-4000 with questions.

Sincerely,



Melissa J. Solari
Data Reviewer



Cosmo Gallinaro
Project Manager

EPA Sample No.	GWPGP004EB	GWPG004TB	GWPGP1204	GWPGP1304	GWPGP1304D	GWPGP1404
Lab Sample ID:	13862.01	13862.06	13862.02	13862.03	13862	13862
Matrix:	Water	Water	Water	Water	Water	Water
Level:	Low	Low	Low	Low	Low	Low
Date Collected:	5/22/93	5/22/93	5/22/93	5/22/93	5/22/93	5/22/93
Date Analyzed:	5/25/93	5/24/93	5/23/93	5/25/93	5/25/93	5/25/93
Dilution Factor:	1	1	1	1	1	1
Units:	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Compound						
Chloromethane	10 U	10 U	10 U	10 U	10 U	10 U
Bromomethane	10 U	10 U	10 U	10 U	10 U	10 U
Vinyl Chloride	10 U	10 U	10 U	10 U	10 U	10 U
Chloroethane	10 U	10 U	10 U	10 U	10 U	10 U
Methylene Chloride	10 U	10 U	10 U	10 U	10 U	10 U
Acetone	10 U	10 U	10 U	7 J	10 U	10 U
Carbon Disulfide	10 U	10 U	10 U	10 U	10 U	10 U
1,1-Dichloroethene	10 U	10 U	10 U	10 U	10 U	10 U
1,1-Dichloroethane	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichloroethene (total)	10 U	10 U	10 U	10 U	10 U	10 U
Chloroform	4 J	1 J	10 U	10 U	10 U	10 U
1,2-Dichloroethane	10 U	10 U	10 U	10 U	10 U	10 U
2-Butanone	10 U	10 U	10 U	10 U	10 U	10 U
1,1,1-Trichloroethane	10 U	10 U	10 U	10	11	10 U
Carbon Tetrachloride	10 U	10 U	10 U	10 U	10 U	10 U
Vinyl Acetate	10 U	10 U	10 U	10 U	10 U	10 U
Bromodichloromethane	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichloropropane	10 U	10 U	10 U	10 U	10 U	10 U
cis-1,3-Dichloropropene	10 U	10 U	10 U	10 U	10 U	10 U
Trichloroethene	10 U	10 U	10 U	22	25	10 U
Dibromochloromethane	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2-Trichloroethane	10 U	10 U	10 U	10 U	10 U	10 U
Benzene	10 U	10 U	10 U	10 U	10 U	10 U
trans-1,3-Dichloropropene	10 U	10 U	10 U	10 U	10 U	10 U
Bromoform	10 U	10 U	10 U	10 U	10 U	10 U
4-Methyl-2-Pentanone	10 U	10 U	10 U	10 U	10 U	10 U
2-Hexanone	10 U	10 U	10 U	10 U	10 U	10 U
Tetrachloroethene	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2,2-Tetrachloroethane	10 U	10 U	10 U	10 U	10 U	10 U
Toluene	2 J	10 U	10 U	10 U	10 U	10 U
Chlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U
Ethylbenzene	10 U	10 U	10 U	10 U	10 U	10 U
Styrene	10 U	10 U	10 U	10 U	10 U	10 U
Xylene	10 U	10 U	10 U	10 U	10 U	10 U

Notes:

J = The reported value is an estimated quantity.

U = The analyte was analyzed for, but not detected.

ug/L = micrograms per liter

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REVISED TEXT

REMOVE EXISTING SECTIONS 6 AND 7

INSERT NEW SECTIONS 6, 7 AND 8

Section 6
removed &
passed to
Diane Sharrow

1.0

INTRODUCTION

The document details results of a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) conducted by WW Engineering & Science at the former Amphenol facility, 980 Hurricane Road, Franklin, Indiana. This report is submitted to U.S. EPA Region V in partial fulfillment of the requirements of a U.S. EPA Administrative Order on Consent (Consent Order), dated November 27, 1990, and directed to respondents Franklin Power Products, Inc., and Amphenol Corporation. Franklin Power Products, Inc. is the owner of record. Respondents are responsible for conducting this RFI and, if necessary, a Corrective Measures Study (CMS).

2.0

SITE HISTORY

Background information regarding the former Amphenol facility, and a summary of previous investigations is provided in this section. Several illustrations from previous investigative reports which summarize previous site data collected prior to the initiation of this RFI, are included.

2.1

Location and Physical Setting

The former Amphenol facility covers an area of about 15 acres. It is located in part of the Northwest Quarter of the Northwest Quarter of Section 13, T.12N., R.4E., on the northeastern side of Franklin, Indiana (Figure 1). The property is bounded on the east by Hurricane Road, on the south by Hamilton Street, on the north by an abandoned rail line, and on the west and northwest by a Farm Bureau Co-Op facility and Arvin Industries, respectively. A Grimmer-Schmidt facility is located east of the site across Hurricane Road. To the south, southeast and southwest, the land use is primarily residential. Approximately 6 acres of the property is used by Franklin Power Products subsidiary companies for manufacturing purposes. The remainder of the property is leased for farming operations or maintained in grass. The site is relatively flat with approximate elevations ranging between 730 and 735 feet above Mean Sea Level (MSL).

The main structure on the facility is a 46,000 square foot building formerly used in the manufacture and distribution of electrical components. The building is now occupied by International Fuel Systems, Inc., which manufactures fuel injectors for diesel engines, and Marine Corporation of America, which assembles marine diesel engines. Other buildings include a separate waste water pretreatment building, now used for storage, and a small single-

bay garage, also used for storage. The area surrounding the main building is either paved parking area, driveway, or grass. The property is unfenced.

Surface drainage from a large area north of the property enters a 72-inch storm sewer at an infall located on the Arvin property immediately adjacent to the northwest corner of the property. The location of this storm sewer is shown on Sheet 1. The storm sewer lies along the western property boundary and receives additional flow from a sewer opening on Farm Bureau property located about 450 feet south of the northwest property corner. At the southwest property corner, the storm sewer turns east. Directly south of the main production building, the sewer turns south again and extends to Hamilton Avenue. At Hamilton Avenue, it again turns and runs east along the south property line. The storm sewer crosses under Hamilton Avenue in the extreme southeast corner of the property, and discharges to Hurricane Creek at a point approximately 1200 feet southeast of the site. Hurricane Creek has a drainage area of about 15.6 square miles above the storm sewer outfall (IT, 1988).

Surface drainage from the northern portion of the property enters a low, wide, natural swale that trends northeast-southwest across the property. This swale appears to be internally drained, and the direction of water flow is unknown. The southeastern portion of the property drains southeast to Hamilton Avenue and Hurricane Road, thence into a storm sewer manhole located in the inside of the roadway where Hamilton Avenue turns north into Hurricane Road (Sheet 1).

2.2 Previous Use of Property

The main manufacturing building on the site was built in 1961 by Dage Electric, Inc. for the manufacture of electric connectors. The operation was acquired in 1963 by Bendix Corporation for its Bendix Connector Operations plant. Processes included electroplating, machining, assembling and storing manufactured components, and inventorying raw materials and compounds required for production. Electroplating operations occurred in a room in the extreme southwestern portion of the building. From 1961 to 1981, wastewater from plating operations at the facility was discharged directly into a municipal sanitary sewer. The location of this sanitary sewer (labeled "old sanitary sewer") is shown on Sheet 1.

In 1981, a wastewater pretreatment system was installed in a separate building for treatment of cyanide and chromium bearing wastewaters from the plating room. New wastewater lines were installed from the plating room to the pretreatment building, and the effluent from the pretreatment plant was routed to a sanitary sewer manhole just south of the main manufacturing

building. In conjunction with the construction of the pretreatment building, a small addition was added to the southwest corner of the manufacturing building, adjacent to the plating room. This addition was evident from examination of historic aerial photographs dated 1976 and 1988. The space was utilized as a RCRA container storage area, and replaced a previous outdoor, fenced, hazardous waste storage area at this same location.

In 1983, the Bendix Corporation was acquired by Allied Corporation and merged with its Amphenol Products Division. As a result of consolidation efforts, manufacturing at the Franklin facility ceased in September, 1983, and the plant was closed at that time. Closure of RCRA units began in February, 1984, and is discussed in detail in Section 2.3.6.

In 1986, Amphenol Products Division became the Amphenol Corporation, and in 1987 it was sold and became a wholly owned subsidiary of LPL Investment Group, Inc. Amphenol sold the facility to Franklin Power Products, Inc. on June 15, 1989.

2.3 Previous Investigation and Remedial Response

2.3.1 Hydrogeologic Investigations by ATEC, 1984

A hydrogeologic investigation of the facility was initiated in February, 1984 by Allied Corporation concurrent with plant closure activities, and in anticipation of the sale of the property. The investigation entailed the collection and analysis of soil samples and ground water samples for volatile and semivolatile organic compounds, pesticides/PCBs, EP TOX metals and cyanide. Initially, in February, 1984, five soil borings (Figure 2, Wells 1 to 5) were made to depths of 30 feet, and a monitoring well was installed in the shallow sand unit at each location. In addition, two hand auger holes were made beneath the floor of the plating room, and samples were collected at 0.5-1.0 and 1.5-2.0 foot depth. Ground water samples were collected on February 22 from wells 1 through 4, and soil samples at 3.5-5.0, 8.5-10.0, and 13.5-15.0 foot depth from monitoring well borings A-1, A-2 and A-3 were analyzed. Results of this investigation were presented in a report dated May 17, 1984 (ATEC, 1984a).

A total of 10 volatile organic compounds were detected in ground water. Concentrations of tetrachloroethene (PCE) and trichloroethene (TCE) up to several thousand micrograms per liter (ug/l) were detected in wells adjacent to the main facility building, particularly along the southwest corner adjacent to the plating room. The presence of the VOC contamination was confirmed by the analysis of the soil boring and hand auger samples. Lateral ground water flow

direction was determined to be to the south based on water levels from the initial well network. TCE (1,040 ug/l), PCE (611 ug/l) and toluene (5.4 ug/l) were detected in an upgradient monitoring well A-4.

ATEC continued the facility investigation in June, 1984. Twelve additional wells (Figure 2, Wells 6 to 17), including a four-well cluster, were installed. These wells sampled the uppermost sand aquifer as well as deeper units. The twelve new wells and the five original wells were sampled on August 29, 1984 and samples were analyzed for VOCs. The complete well system provided a total of twelve monitoring points in the shallow sand unit, and ground water flow to the south was verified by August water level measurements (Figure 3). Volatile organic contaminants, principally PCE, TCE, and 1,1,1-trichloroethane (TCA), were detected at all well locations except A-9 (MW-9 in this RFI report). Contamination at upgradient monitoring well A-4 was confirmed, and substantial PCE and TCE concentrations were also found at upgradient locations A-7 (600 and 430 ug/l) and A-8 (835 and 876 ug/l). A VOC concentration of 27,000 ug/l of TCA was found at well A-12 (MW-12 in this RFI report) located along a sanitary sewer downgradient from the facility. Analytical data were tabulated in a report (ATEC, 1984b), and are included as part of Appendix A in this report.

2.3.2 Sanitary Sewer Line

In July, 1984 ATEC conducted a video camera inspection of the sanitary sewer line leading south from the plant. The sewer was determined to be eight inch vitrified clay tile and was found to have numerous separated joints. Crushed tiles, an offset pipe joint, and an apparent PVC patch were found in an area 157 to 176 feet north of a manhole along Hamilton Avenue. This area corresponds to the location where the 72-inch storm sewer crosses under the sanitary line. Examination of historic aerial photographs suggest that the storm sewer was installed shortly before August, 1976.

In May, 1985, Allied/Bendix installed a replacement sanitary sewer approximately 35 feet east of the damaged sewer. The new sewer line was offset from the old line to avoid excavation of possibly contaminated soils. Location for the new line was established based on the results of VOC analyses of soil samples collected in December, 1984. This sampling revealed negligible soil contamination at a distance of 35 feet from the old sewer line.

Installation of the new sewer line involved excavation to the existing line at manholes upstream and downstream of the damaged line, plugging the ends of the old sewer with concrete,

installation of two new manholes offset 35 feet from the old line, and installation of about 300 feet of new 8 inch PVC sewer line. The old sewer line was not removed.

2.3.3 Plating Room Investigation, 1984

In August 1984, ATEC conducted an investigation of soils beneath the plating room floor at the southwestern corner of the facility. A total of 32 hand auger borings were made in the plating room and adjacent areas. Samples were collected at depths of 0.5-1.0, 2.5-3.0 and 4.5-5.0 feet. Samples were analyzed for VOCs and cyanide, and results were included in a summary report (ATEC, 1984c). Soils were found to be contaminated with cyanide and certain VOCs, primarily PCE and TCE. Recommendations provided for removal of 15 to 20 cubic yards of soil to a secure landfill.

Allied/Bendix contracted with the Environmental Remedial Action Division of Chemical Waste Management to begin a voluntary cleanup of the plating room facilities, and to excavate and dispose of soils, as necessary, beneath the plating room floor. Remedial work began in May, 1985. Venting and duct work was dismantled and crushed. A polyethylene floor covering was cut into sections and removed, and the underlying concrete floor was removed with air hammers. Soils beneath the plating room were removed to depths as great as nine feet below the former floor level. A total of 443.31 tons of contaminated soils, 128.57 tons of concrete, and the crushed duct work and polypropylene flooring were disposed of at Adams Center Landfill, Fort Wayne, Indiana.

Soils were removed to a clean-up level of 10 mg/kg total cyanide, as documented by sampling of the excavated area after removal of contaminated soil. After soil removal, the walls of the excavation were sprayed with a 5 percent sodium hydroxide solution, and the bottom of the excavation was flooded with solution. The solution was allowed to percolate into the soil. The excavation was then backfilled with compacted sand, and a new concrete floor was poured.

2.3.4 Hydrogeologic Investigations by IT, 1985

Beginning in February, 1985, Allied began a second hydrogeologic investigation of the facility utilizing International Technology Corporation (IT). This study was begun because of possible deficiencies and inconsistencies in the ATEC investigations, and the need to develop a more comprehensive characterization of ground water flow, ground water quality and contaminant transport on and near the property.

Phase I of the IT investigation involved development and sampling of the previously installed ATEC wells, and the collection of several surface water and storm sewer samples at the locations shown in Figure 4. Data are included in Appendix A. Sampling was conducted in February and March, 1985, and samples were analyzed for metals, VOCs and total cyanide. Ground water samples were collected from 16 of the 17 ATEC wells installed in 1984 (well 14 was not sampled due to a bent and obstructed well casing). A variety of VOCs were detected in all 16 ground water samples analyzed. However, markedly lower levels of contaminants were detected in upgradient monitoring wells 4, 7 and 8 than were reported by ATEC from the sampling events in February and August, 1984 (Appendix A, Table A-1). IT noted that the greatest levels of contaminants appeared to be concentrated in the area south of the former plating room, and extended at least as far as the storm sewer along the south boundary of the property.

Samples of the storm sewer discharge showed elevated levels of several VOCs, principally TCE, PCE and TCA downstream from the plating room area. (Figure 4, Locations SD-1, 3 and 5). A sample from the storm sewer manhole nearest the plating room (SD-2) contained these contaminants at levels comparable to upstream sampling points SD-4 and Arvin 1. The data suggested that the storm sewer acted as a ground water intercept, and that contaminated ground water from the facility was entering the storm drainage system. Most probably this occurred in the area south of the plant where the storm sewer parallels the sanitary sewer for a distance of about 150 feet, and where numerous sewer defects were noted during the July, 1984 video camera inspection (Section 2.3.2).

VOC contaminants were also found in Hurricane Creek at the storm sewer outfall (Figure 4, Location H-2), and at a point downstream in Hurricane Creek (Figure 4, Location H-3). No VOC contaminants were detected in a sample from Hurricane Creek upstream from the storm sewer outfall.

Additional monitoring wells were installed by IT in April, 1985. Several of the older deep ATEC wells were overdrilled, grouted, and abandoned at this time due to concerns over poor well construction. The purposes of the new well installations were to:

- determine if the storm sewer or pipe-bed acted as an intercept to off site contaminant migration;

- determine if any contamination existed in the deeper sand units, notwithstanding previous ATEC results which were attributed to poor well construction;
- determine the type and extent of organic contaminants present in the soil adjacent to the plating room, and to determine if they are affecting ground water quality;
- determine if any contaminants were migrating east or northeast from the facility which could possibly affect the Franklin municipal well field.

Six new monitoring wells, IT-1A and 1B, 2, 3, 4 and 5 were installed (Figures 2 and 4). IT-1A and 1B were paired wells installed to determine the vertical extent of ground water contamination. The deeper well in this cluster, IT-1A was installed in a sand unit at a depth of about 60 feet.

A total of 27 soil borings were made along the west and south sides of the former plating room (Figure 5). Samples for each boring were obtained at 6 to 7.5 foot depth, or at the approximate depth of the former sanitary sewer line leaving the plating room area. Based on February, 1985 sampling results, soil and water samples were analyzed for priority VOCs and certain non-priority VOCs.

Samples from the six new monitoring wells were obtained by IT in May, 1985. In shallow ground water, the priority pollutant volatile organic compounds detected were limited to 1,1-dichloroethane (DCA), toluene, TCA, and TCE. Only toluene at 9.1 ug/l, TCA at 2.2 ug/l, and xylenes at 2.2 ug/l were detected in the deeper sand unit at 60 foot depth at IT-1A. Wells IT-2 and IT-3, located south of the storm drain (Figure 2) were found to contain TCE, TCA, and toluene. No VOCs were detected in IT-4, and IT-5 was found to contain toluene at only 1.6 ug/l. IT concluded that the storm drain along the south boundary of the property was acting as at least a partial ground water intercept (see Figure 6). Based on their 1985 data, IT produced several isoconcentration maps which show the influence of the storm and sanitary sewers on the extent of ground water contamination in the shallow sand unit (Figure 7). These data are tabulated in a final report (IT, 1985).

A total of 11 samples from the plating room borings were analyzed for VOCs. Acetone, benzene, chloroform, 1,1,2,2-tetrachloroethane, TCA and TCE were detected. No large amounts of contaminants were detected, and total VOC content was everywhere less than 3 ppm.

2.3.5 Quarterly Monitoring

Allied/Amphenol submitted a ground water monitoring plan to the Indiana State Board of Health on September 12, 1985. The plan, prepared by IT, established a quarterly ground water monitoring program to be conducted for a period of one year. The program was implemented in February, 1986, and was conducted through November, 1986. Samples from wells IT-1A, IT-2, IT-3, MW-3, MW-9 and MW-12, as well as the storm sewer outfall were analyzed for VOCs. Results were generally similar to the 1985 testing, and are included in Appendix A. Of note are values from the upgradient well (MW-9) which showed concentrations for PCE, TCE and TCA above detections levels for multiple sampling periods, and the continuing detection of VOCs, including PCE, TCE and TCA, in the storm sewer outfall at Hurricane Creek.

2.3.6 Closure and Corrective Measures Activities

The following closure and corrective measures activities were conducted at the Amphenol facility in response to the previously described investigations:

- Removed and disposed of the plating room floor and underlying soil to a depth of nine feet, treated the excavation with calcium hypochlorite and installed clean backfill and a new concrete floor;
- Disconnected and plugged the old sanitary sewer line and replaced it with a new line offset 35 feet east of the old one;
- Drained and treated the wastewater treatment system, the plating room tanks and other areas in the plating room;
- Drained and treated the underground cyanide overflow tank, and capped the pipes at the discharge end;

- Removed twelve previously installed ground water monitoring wells and grouted the boreholes to the surface.

In response to an IDEM Notice of Violation dated 6/25/87, Amphenol filed a total closure plan dated August 10, 1987, and as per IDEM review amended this plan on March 13, 1989. The plan addressed closure of a container storage area (ID No. S01) and the cyanide tank (ID No. S02). Certification of Closure for these units was provided by Amphenol on April 2, 1990. The IDEM notified Amphenol on June 13, 1990 that total closure had been completed as per the requirements of 329 IAC 3-21.

2.4 Geologic Setting

The area is located within the Tipton Till Plain physiographic unit of Malott (1922) which is generally characterized by low relief topography underlain by thick deposits of glacial drift. The surficial drift deposits are Wisconsinan (Woodfordian) in age and consist primarily of loamy textured diamicts (glacial till) as well as stratified sand and gravel deposits. In many places, older glacial drift deposits of pre-Wisconsinan age have been identified.

Four lithostratigraphic units may be recognized in the upper portion of the glacial drift sequence (Figure 8). Previous soil borings conducted during the period 1984 to 1985 suggest the site is underlain by a thin veneer of weathered glacial till about five to eight feet thick (identified as Unit A in this report) which overlies a sand or silty sand deposit (Unit B) which is saturated in the lower part. The top of this sand unit occurs at 712 to 715 feet MSL, or approximately 20 feet below ground surface (Figure 8). The sand overlies a hard, dense till unit 30 to 35 feet in thickness (Unit C), which in turn overlies a second sand unit that is about 12 feet in thickness (Unit D). The bottom of the lower sand unit extends to a depth of about 60 feet below ground surface. Both the lower part of Unit B and Unit D are saturated and yield ground water.

Deeper drift deposits are known from only one boring (Figure 8, MW-13), but appear to consist primarily of till, with thin stratified units occurring at depths of 114.5, 122 and 172 feet. The lowest "basal sand" unit directly overlies shale bedrock. Bedrock beneath the property is the Devonian-Mississippian aged New Albany Shale (Gray and others, 1987), encountered at a depth of 178.9 feet in boring MW-13.

2.5 Hydrogeology

Previous water level elevation data from site monitoring wells suggest a fairly uniform north to south ground water flow gradient within the upper sand and gravel unit. Data gathered by IT on May 3, 1985 suggest that the 72-inch storm sewer flowing along the south boundary of the property may act at least as a partial intercept for ground water flow in the uppermost sand and gravel unit. The water level in well IT-2, located south of the storm sewer, was reported to be over 1.2 feet higher than MW-12 located adjacent to, and north of the sewer. These levels suggest a local reversal of the north to south hydraulic gradient in the storm sewer area.

Hydraulic conductivity of the upper sand unit (Unit B) was estimated by IT from six in situ "slug" tests conducted in the old ATEC monitoring wells (IT, 1985). Calculated values ranged from 3.08×10^{-6} to 9.51×10^{-4} cm/sec. Results may be biased low due to poor well construction, and/or development.

3.0 **SITE INVESTIGATION**

3.1 Scope of Investigations

3.1.1 Areas of Concern

This RFI initially addressed five areas of concern at the former Amphenol facility, as listed in the Consent Order:

- An abandoned sanitary sewer leading from the property;
- A former cyanide waste overflow tank;
- An area believed to have been the location of underground storage tanks containing lapping compounds;
- A former outdoor RCRA storage area;
- Soils in the vicinity of the former plating room.

Results of initial investigative work led to the addition of two more areas of concern which are addressed in this report:

- Soil and ground water at the southwest corner of the paved area of the facility;
- Ground water off-site to the south.

3.1.2 Initial Investigation

The initial scope of investigation for this RFI is provided in a RCRA Facility Investigation Work Plan and Quality Assurance Plan developed by International Technologies Corporation (IT, 1988), which was made a part of the Consent Order. Previous (1984-1985) investigations have provided a substantial geologic and hydrogeologic data base. Data review conducted by IT (1988) indicated that the physical data contained in this data base are valid, but that gaps exist in the analytical data. This investigation was performed to address those deficiencies. Specific objectives of the RFI, as outlined in the Quality Assurance Project Plan (QAPjP), prepared by WW Engineering & Science and approved May 25, 1991, are as follows:

- Determine to what extent hazardous organic and inorganic constituents are present in the soil, the soil gas, and ground water beneath the site;
- Determine to what extent data gathered during previous 1984 to 1986 sampling efforts are a valid indication of the extent of contamination;
- Determine the identity, concentrations and possible sources of ground water contaminants entering the facility property from an upgradient direction, and their contributions of background levels;
- Determine the extent of, and direction and rate of movement of any contaminant plume that has resulted from the release of contaminants on the property;
- Determine whether any plume that exists has left the site boundaries;
- Characterize contaminant pathways;

- Determine the identity and characteristics of any target populations or natural systems in the vicinity of the Amphenol facility.

To meet these objectives, samples were obtained from surface waters and sediments in local streams and storm sewers, soil materials collected from soil borings, soil gas, and ground water from monitoring wells on and adjacent to the site. The first round of site work was conducted between January 28 and April 16, 1992.

3.1.3 Additional Activities

Analytical data obtained from the first round of samples indicated that additional sampling would be necessary to meet the objectives of the RFI. A technical memorandum describing activities and results of the first phase of the RFI, dated June 23, 1992, was submitted to Region V, U.S. EPA. The memorandum, included as Appendix B of this report, listed the following objectives for additional RFI work:

- Evaluation of a potential separate PCE ground water plume at the southwest corner of the facility parking lot;
- Additional sampling points to delineate the plume boundary in Unit B south of the storm sewer (off-site);
- Evaluation of the storm sewer and storm sewer trench as a possible pathway for contaminant migration, and delineation of any plume extension along the storm sewer;
- Evaluation of ground water flow patterns and contaminants in storm sewer water during periods when ground water levels are above the bottom of the storm sewer;
- Evaluation of possible sources of contamination to Unit D, perhaps utilizing additional well purging and sample analysis;
- Evaluation of Unit B thickness south of the site.

To meet these objectives, additional soil, surface water and ground water samples were collected both on and off-site in accordance with a Work Plan dated October 12, 1992, and a supplement

to that Work Plan, dated December 28, 1992. Additional sampling of selected monitoring wells and surface water took place on July 27, 1992. Additional soil boring, monitoring well installation, soil sampling and well purging activities were conducted between January 13 and February 17, 1993. On-site and off-site surface and ground water sampling, was performed between February 16 and March 2, 1993. Off-site work was performed with a hydraulic Geoprobe apparatus in lieu of permanent monitoring well construction, in accordance with the December 28, 1992 Work Plan supplement.

3.2 Site Mapping

Prior to commencement of RFI field work, planimetric horizontal and vertical ground controls were established by survey. A point in the southeast corner of the property was selected as a beginning point and a base line bearing N 00°30'00" W, parallel to Hurricane Road was established. An orthogonal east-west base line was also established. Panels were located at four property corners for aerial photography planimetric correction. Temporary Bench Marks (TBMs) were established on the two new sanitary sewer manhole rims located on the property south of the main building. All site level survey work was based on these TBM points. Horizontal locations used in the on-site soil gas report are based on north and west coordinate measurements obtained by tape measurements off the survey base lines.

Aerial photography of the facility was obtained on January 12, 1992 and was utilized to prepare a topographic site base map at a scale of 1 inch equals 50 feet (Sheet 1). This base map was utilized in the preparation of drawings throughout this report. The aerial photograph of the property is shown on Sheet 2.

Additional historic stereo aerial photographs dated September 18, 1962, August 30, 1976 and September 27, 1988 were obtained from the Indiana Department of Highways and Johnson County and utilized during this investigation.

Locations and elevations of soil borings, monitoring wells and Geoprobe sampling points were determined by survey. Values for northing, easting, and elevation are shown in Appendix C.

3.3 Soil Boring and Monitoring Well Installation

Nine soil borings (SB-1 through SB-9) and seven monitoring wells (MW-20 through MW-26) were installed between February 4 and 26, 1992. With the exception of MW-26, added during

Consent Order negotiations, these well and boring locations were specified in the IT Work Plan (IT, 1988), and made a part of the Consent Order. Four additional Monitoring wells (MW-27 through MW-30) were installed between January 13 and 15, 1993 at locations specified in the October 12, 1992 Work Plan (WWES, 1992). Monitoring wells MW-3, -9, and -12, previously installed by ATEC (Section 2.3.1), and monitoring wells IT-1A, IT-2, and IT-3, previously installed by IT (Section 2.3.4) were also used in this RFI for ground water sampling and water level measurement. Soil boring and monitoring well locations are shown on Sheet 3. Soil samples were collected from soil borings for physical description and classification. Soil samples for description and classification were also collected at nine locations off-site (PGP-1, -2, -3, and -6 through -11) between February 16 and March 2, 1993. These locations were either specified in the December 28, 1992 Work Plan supplement (WWES, 1992), or were added at the discretion of the RFI project manager. These PGP samples were collected with a Geoprobe apparatus. Soil classification logs for all soil samples are provided in Appendix D.

Soil borings SB-1 and SB-2, located immediately adjacent to the in-ground cyanide overflow tank, were installed by hand auger. These borings were made to depths of 1.0 and 3.0 feet beneath the bottom of the tank (10.0 and 12.0 feet below the surface, respectively). Initially, it was planned that these borings would be made through the bottom of the tank. However, it was found in the field that the concrete tank did not have a removable lid. For safety reasons it was decided that rather than work through the very small surface access opening, soil borings would be made from the surface at each end of the tank.

Soil borings SB-3 through SB-9 were installed utilizing conventional hollow stem auger and split spoon sampling techniques. Borings SB-3 and SB-4 were located in the area of purported buried lapping compound tanks along the west side of the main plant building, and were made to investigate any potential leakage from these tanks. Attempts to locate the tanks with metal detectors and probe rods were unsuccessful. Borings were placed in an area where the tanks were purported to have existed, and were advanced to a depth of 10 feet. The locations were established by interviewing an Amphenol employee formerly assigned to the Franklin operation at the time the tanks were utilized.

Boring SB-5 was located immediately outside of a roofed, fenced enclosure, also along the west side of the building and was made to a depth of 17 feet. This boring was to be used to evaluate potential spills from a former RCRA storage area which was believed to have been within the enclosure. Subsequent research has suggested that the former RCRA storage area was located outside the northwest corner of the plating room, and that the fenced area in question was never

utilized to store hazardous waste. Soil borings SB-1 and SB-2 were installed in this area (Sheet 3).

Borings SB-6 and SB-7 were located along the former sanitary sewer line between existing monitoring well MW-12 and new, paired monitoring wells MW-22/MW-23. Borings SB-8 and SB-9 were made along the south side of the plating room near existing monitoring well MW-3. These locations are also directly down gradient of the former RCRA storage area.

Soil borings which were not developed into monitoring wells were backfilled with Portland cement grout upon completion.

Soil classification profiles were constructed from samples collected by Geoprobe at off-site locations southeast (PGP-1), south (PGP-2, PGP-8, -9, -10 and -11) and southwest (PGP-3, -6, and -7) of the site. These profiles were examined in preparation for ground water sampling at each location.

Monitoring wells were constructed in accordance with the RCRA Ground Water Monitoring Technical Enforcement Guidance Document (OSWER 9950.1 Sept., 1986), as detailed in the 1988 Work Plan, with the following exceptions:

- No water was used in the installation of the filter-pack sand;
- Laboratory-grade deionized (DIW) water was added to the well pipe as required to counteract the buoyant force of well fluids, and to clean fine soil particles from the well screen;
- Where installation of the bentonite seal was made above the saturated zone, three gallons of laboratory-grade DIW were added to the borehole to hydrate the pellets.

Summary monitoring well data including horizontal grid coordinates, top of casing and ground elevations, and screened intervals, are recorded in Appendix E. Ground water levels are shown in Table 1. Monitoring wells MW-20, -21, -22, -24, -26 and -27 through -29 are completed in the upper sand and gravel unit (Unit B). Monitoring well MW-30 was completed in the storm sewer trench. Wells MW-23 and -25 are completed in the lower sand unit (Unit D) approximately 60 feet deep. Three paired shallow sand/deep sand installations were made where

vertical hydraulic gradients and levels of contaminants could be compared between the two units. These paired installations consisted of MW-22/23, MW-12/25 and MW-24/IT-1A.

Monitoring wells MW-23 and -25 were installed utilizing a double well casing to limit the potential for cross contamination between the shallow and deep sand units. The following procedure was utilized. A hole was drilled through the shallow sand unit and into the top of the underlying glacial till. A large diameter casing was then inserted in the hole, and cemented inside and out to the surface. After the cement had set a minimum of 24 hours, the cement inside the casing was drilled out, and the boring was advanced to the 60 foot depth utilizing hollow stem auger drilling techniques through the surface casing.

Borings SB-6 and SB-7, monitoring wells MW-12, IT-1A, IT-2, IT-3, MW-22 through -25, MW-27 and MW-30 served to investigate conditions around the old sanitary sewer line. Soil borings SB-8 and SB-9, and monitoring wells MW-3 and MW-21 provided samples from the vicinity of the former plating room and RCRA storage area. Monitoring wells MW-9, MW-20 and MW-26 were utilized as upgradient sampling points. Monitoring wells MW-27 and MW-28 served to investigate an area of PCE contamination detected at the southwest corner of the paved area of the site during the on-site soil gas survey. Geoprobe samples PGP-1, -2, -3, -6, -7, -8, -9, and -10 served to investigate off-site ground water contamination. Geoprobe samples PGP-4S and -4D served as checks by providing Geoprobe ground water samples adjacent to monitoring well MW-12.

3.4 Aquifer Testing

Hydraulic conductivity of the Unit B sand was estimated from "mini-rate" pump tests conducted in monitoring wells MW-12 and MW-24 on September 2, 1992. Each well was pumped at a constant rate with a peristaltic pump, and drawdown was monitored with a pressure transducer and an electronic data logger. Data logger records and time-drawdown curves are presented in Appendix F.

Monitoring well MW-12 was pumped at 1.16 gallons per minute (gpm) for 60 minutes, resulting in drawdown of 0.58 feet. Monitoring well MW-24 was pumped at 4.17 gpm for 67 minutes, with 0.48 feet of drawdown. Walton's (1962, 1985) specific capacity formula was used with an assumed storage coefficient of 0.20 to compute transmissivity values of 2,200 and 11,300 gpd/ft (gallons per day per foot) for MW-12 and MW-24, respectively. For saturated thicknesses of 6.9 (MW-12) and 6.0 feet (MW-24), the transmissivity values equate to hydraulic conductivities of

320 gpd/ft² at MW-12 and 1860 gpd/ft² at MW-24. Although markedly different from one another, these values are consistent with the fine to coarse sand texture seen in samples of the aquifer material.

3.5 Sample Types and Locations

The following types of analytical samples were collected:

- Soil gas samples from 30 locations on the site;
- Surface water and sediment samples from five locations along the storm sewer drainage system and Hurricane Creek;
- Soil samples from the nine soil borings and from eight of the eleven new monitoring well borings;
- Ground water samples from the eleven new monitoring wells, and six previously installed monitoring wells, collected by stainless steel bailer;
- Ground water screening samples from 10 locations on-site and 33 locations off-site, collected with the Geoprobe apparatus;
- Ground water samples from one location on-site and eight locations off-site, collected with the Geoprobe apparatus utilizing stainless steel and Teflon bailers.

The on-site soil gas survey was performed to provide a preliminary assessment of the extent of VOC contamination in soil and shallow ground water. The results of this soil gas survey were prepared as a Technical Memorandum and submitted as a draft to Region V EPA on April 8, 1992. The Technical Memorandum is included in this report as Appendix G. Figure 1 of Appendix G shows the location of soil gas sampling points with respect to the site coordinate grid.

Surface water and sediment sampling points are shown in Figure 9. Sampling points SW/SD-01 and SW/SD-05 represent upstream Hurricane Creek and upstream storm sewer samples, respectively. These locations correspond to previous 1985 IT sampling points H-1 and SD-4

(Figure 4). Point SW/SD-02 is the storm sewer discharge point. Points SW/SD-03 and SW/SD-04 are on Hurricane Creek downstream from the storm sewer outfall. The SW/SD-03 location is at the Forsythe Street bridge over Hurricane Creek, located approximately 1000 feet downstream from the storm sewer outfall into Hurricane Creek. Point SW/SD-04 is located in the City of Franklin Jack Morgan Park, and was located about 200 feet upstream from IT sampling point H-3. Surface sediment samples were collected from all SD points on February 25, 1992. Field determinations of pH, temperature, specific conductance, dissolved oxygen and stream flow were made at each SW point between February 25 and March 25, 1992. Stream water samples for VOCs, total cyanide and amenable cyanide were collected from surface water sampling points SW-01, SW-02 and SW-05 on February 25, 1992. Surface water samples for VOCs and total and amenable cyanide were obtained at point SW-02 again on July 27, 1992 and February 17, 1993.

Analytical soil samples were collected from selected intervals in soil borings SB-1 through SB-9, MW-20 through MW-27, and MW-30. Sample selection was based in part on soil head-space (HNu) screening results, which are included in Appendix D. Analytical samples were analyzed for VOCs, metals, and total and amenable cyanide. Samples from above and at the water table served to determine the identification and concentration of subsurface contamination. Samples of the till beneath the upper sand unit in boring MW-23 and MW-25 were obtained to address the possibility of contaminant migration into the deeper sand aquifer. Surface samples were collected at locations SB-5, SB-8 and MW-22 for risk evaluation purposes. Background soil samples were collected at two boring locations MW-20 and MW-26.

New monitoring wells MW-20 through MW-26, monitoring wells MW-3, MW-9 and MW-12, previously installed by ATEC, and monitoring wells IT-1A, IT-2 and IT-3, installed previously by IT, were sampled in March and April, 1992. Prior to this initial sampling, each well was developed by bailer surging to remove fines from the well screen area. Approximately ten well volumes were removed from most shallow wells, but low yield prevented this volume of purging in wells MW-12, -20 and IT-2. Deep wells MW-23, -25 and IT-1A were purged of three casing volumes. All development water was contained in polyethylene tanks at a central location on-site. During the initial development, a large steel treble hook, cotton string, and several lead sinkers were removed from MW-12. These are presumed to have been lost at some point in the past, possibly from a previous attempt to retrieve lost sampling equipment. Monitoring wells MW-12, MW-22, IT-2 and IT-3 were sampled in a second sampling round on July 27, 1992. Monitoring wells MW-12, -22 through -25, and -27 through -30, IT-1A, IT-2 and IT-3 were sampled in a third sampling round February 16 and 17, 1993.

Following ground water sampling rounds one and two, additional ground water quality data were obtained off-site by collecting VOC screening samples with a Geoprobe, and analyzing them for target compounds DCA, TCA, TCE, and PCE in the sampling vehicle utilizing an on-board GC with purge-and-trap in accordance with the December 28, 1992 supplement to the October 12, 1992 Work Plan (WWES, 1992). Rapid collection and analysis of screening samples facilitated qualitative delineation of areas for collection of ground water samples by techniques prescribed in the Work Plan supplement (WWES, 1992).

Initial sampling for screening of the ground water was conducted between November 4 and 6, 1992. Results of this screening were prepared as a Technical Memorandum submitted to Region V EPA on November 23, 1992 and included in this report as Appendix H. Figure 1 of Appendix H shows the locations of ground water screening samples collected during phase I of the screening. Sampling for phase II of the ground water screening was conducted between February 16 and 24, 1993. A total of 20 ground water samples (PGP-9 through -28) were collected southeast, south, and southwest of the site as shown in Sheet 3.

Based on results of the off-site ground water screening, ground water samples for laboratory analysis were collected from eight off-site locations and one on-site location with the Geoprobe. Sampling locations are shown on Sheet 3.

3.6 Sampling Methods

3.6.1 Soil Gas

Soil gas sampling methods are detailed in Appendix G. At each sampling point, two samples were collected, one from six feet and one from eight feet below the surface. Samples were analyzed for trichloroethene (TCE), perchloroethene (PCE), and trans-1,2-dichloroethylene (DCE).

The soil gas pilot survey and sampling were performed January 28-30, 1992. Several techniques were used which varied from those proposed in the QAPjP (WWES, 1990), owing to increased knowledge of the site, and improved analytical and sampling equipment. Variations from the QAPjP are provided in Appendix G.

A total of 55 samples was collected. Soil-vapor samples were analyzed on-site utilizing a Photo-Vac 10S55 portable gas chromatograph (GC) equipped with a built-in integrator.

The QAPjP provided for external GC calibration utilizing TCE gas standards, and quantification of total VOCs in the sample based on total peak area and a TCE calibration factor. The GC was initially calibrated with TCE and trans-1,2-dichloroethylene. Initial sampling work indicated that with few exceptions, only TCE and an unknown compound appeared in the soil gas. The unknown compound was identified as PCE after an external standard for that compound was obtained.

3.6.2 Soil Samples

Soil samples were collected from nine soil borings and seven new monitoring well borings between February 4 and 26, 1992 and from one additional monitoring well boring January 13, 1993. Soil boring and monitoring well locations are shown on Sheet 3. Details of the depth intervals sampled in each boring are shown in Table 2.

Samples from borings SB-1 and SB-2 were retrieved with a 3-inch stainless steel hand auger and transferred directly from the auger to sample containers with a stainless steel spatula. All other analytical soil samples were collected during hollow-stem auger drilling using conventional split spoon sampling techniques. Samples were collected following procedures detailed in the QAPjP with following exceptions:

- Analytical samples were collected in large, 3-inch diameter split spoons to assure sufficient sample volume for analysis;
- Each 3-inch split spoon was subjected to a detergent/steam wash, a nanograde methanol rinse and a deionized water rinse prior to analytical sample collection;
- Samples for VOC analysis were collected into two 125 ml wide-mouth glass jars, and for cyanide analyses, into a single 250 ml amber glass jar.

Samples were collected for VOC, metals, total cyanide and amenable cyanide analyses. Soil samples were transferred from the split spoons to sample containers with a pre-cleaned stainless steel spatula. Analytical data are provided in Table 3.

3.6.3

Surface Water and Sediment Samples

Stream water samples for VOCs, total cyanide and amenable cyanide analyses were collected from sampling points SW-01, SW-02 and SW-05 on February 25, 1992. Point SW-02 was sampled again on July 27, 1993 and February 17, 1993. Temperature, pH, specific conductance, dissolved oxygen content and stream discharge were determined at all stream water sampling points. These data are provided in Table 4. Samples were obtained and handled in accordance with the QAPjP (WWES, 1990), with the following exception:

- Where shallow water prevented collection of a full container by submersion, the remainder of the sample was collected by dipping water with the bottle cap.

The stream water dissolved oxygen content was determined at each stream station on March 25, 1992. An attempt to measure dissolved oxygen when the stream water samples were collected February 25 was unsuccessful due to equipment malfunction. Data were obtained by two different methods on March 25. Dissolved oxygen content was determined electronically utilizing a Yellow Springs Instrument (YSI) model 51B dissolved oxygen meter, and titrimetrically with a *HACH* model OX-2P test kit. The YSI probe was placed directly in the stream water. A sample of stream water was obtained for immediate titration following the procedures given in the *HACH* kit. Data from both techniques are presented in Table 4.

Stream discharge was determined at sampling points SD/SW-01, SD/SW-02, SD/SW-03, and SD/SW-04 on February 25, 1992 by the pygmy current-meter method and at point SD/SW-05 by the modified Parshall flume method (Buchanan and Somers, 1976). Discharge was determined again at point SW-02 on July 27, 1992 by the pygmy current-meter method. Discharge data are included in Table 4. Laboratory analytical data for the surface water samples are provided in Table 5.

Stream sediment samples for VOCs, metals, total cyanide and amenable cyanide analyses were collected from each stream sampling point on February 25, 1992. Metals and cyanide samples were collected into a single 250 ml amber glass jar. VOC samples were collected in two 125 ml glass jars. Samples were collected in accordance with procedures given in the QAPjP (WWES, 1990). At points SD-02 and SD-05, grab samples were collected from the midpoint of the streambed. At points SD-01, SD-03 and SD-04, composite samples were collected by

homogenizing three aliquots of sediment collected from equally spaced points across the stream bed. Analytical data are provided in Table 6.

3.6.4 Ground Water

3.6.4.1 Monitoring Wells

Three rounds of ground water sampling were conducted. Sampling round one was conducted between March 2 and April 16, 1992. Monitoring wells MW-3, -9, -12, -20 through -24, MW-26, IT-1A and IT-3 were sampled March 2 and 3, 1992. At this time monitoring well IT-2 was purged to dryness, and monitoring well MW-25 was found obstructed by a small plug of bridged bentonite. Well IT-2 was sampled on March 4. Well MW-25 was developed on March 9 and sampled on March 10. Wells IT-1A, IT-2, MW-21 and MW-26 were resampled on March 6 for cyanide only due to sample bottles being broken in shipment. Monitoring well MW-26 was resampled for cyanide on April 3 and April 16, again due to broken sample bottles.

Monitoring wells IT-2, IT-3, MW-12 and MW-22 were sampled during sampling round two, conducted July 27, 1992. Sampling round three was conducted February 16 through 24, 1993. Monitoring wells IT-1A, IT-2, IT-3, MW-12, MW-22 through -25 and -27 through -30 were sampled February 16 and 17.

Samples were collected for VOCs, total metals, total cyanide, and amenable cyanide analyses. Samples from wells MW-12 and MW-22 were analyzed for both total and dissolved metals. During round one, wells MW-12 and MW-22 were sampled for additional parameters listed in 40 CFR Part 264 Appendix IX, but excluding organo-chlorine pesticides as listed in Exhibit A of the Consent Order.

Prior to sampling round one, each well was tested in an undisturbed state for the presence of high and low density non-aqueous phases utilizing a *Keck* interface probe. Each well except MW-12 and IT-2 was then purged of a minimum of three casing volumes. Wells MW-12 and IT-2 were purged to dryness. Samples were collected and handled in accordance with the QAPjP with the following exceptions:

- Each Appendix IX sample for phenols and SVOCs was collected into a single one liter amber glass bottle with no preservatives added;

- Each sample for PCBs, pesticides, dioxins and furans was collected into a single two liter amber glass jar;
- Each sulfide sample was collected in a 500 ml polyethylene bottle and preserved with sodium hydroxide and zinc acetate.

Ground water field-chemistry data are presented in Table 7, and analytical data are provided Table 8.

Samples collected from monitoring wells MW-23, MW-25 and IT-1A (screened in the saturated zone identified as Unit D on Sheets 4A and 4B) during ground water sampling round one contained very low concentrations of VOCs as discussed in Section 4.7.2 (see Table 8). As a means of addressing the possibility that the VOCs were "carried down" to Unit D from Unit B during installation of the deep monitoring wells, each well was redeveloped prior to sampling during round three. Redevelopment was accomplished by pumping each well for several hours with a submersible pump. Redevelopment activities and accomplishments are tabulated in Table 9.

3.6.4.2 Geoprobe Sampling

3.6.4.2.1 Ground Water Screening

Ground water samples were collected from selected locations on- and off-site with the Geoprobe and analyzed for VOCs on board the sampling vehicle as an efficient means of qualitatively delineating contaminated areas and identifying additional analytical sampling locations. These "screening" samples were collected in accordance with the Work Plan (WWES, 1992). Ground water screening samples were collected on-site between November 4 and 6, 1992. Results of this screening are included in Appendix H. Off-site ground water screening was conducted from February 1 through April 1, 1993. Results are provided in Table 10.

3.6.4.2.2 Ground Water Analytical Sampling

Ground water samples for CLP contract laboratory analyses were collected from selected locations on- and off-site as discussed in Section 3.5. Samples were collected following

procedures described in the Work Plan supplement (WWES, 1992). Sample locations (PGP-1 through PGP-10) are shown on Sheet 3, and analytical results are included in Table 8.

3.7 Decontamination Procedures

During the on-site soil gas sampling, each sample was collected with new tubing into a new sampling bag. The sampling train was purged with at least two liters of soil gas before sample collection commenced. The probe was washed with a detergent solution and rinsed with deionized water as needed between sampling points to prevent the transfer of potentially contaminated soil from one sampling location to another.

Equipment used in the installation of soil borings and monitoring wells was decontaminated prior to use at each boring. Hollow stem augers, bits, and split spoons were steam cleaned at the decontamination pad. The three inch split spoons were rinsed with nanograde methanol, and all spoons were rinsed with laboratory grade deionized water. Split spoons were stored and transported on clean plastic sheeting. Utensils used during soil sample collection were washed with an *Alconox* detergent solution and rinsed with laboratory-grade deionized water prior to each use. Well construction materials were either received pre-cleaned and sealed in new plastic wraps or steam-cleaned on-site immediately prior to use.

At each drilling site an exclusion zone was defined. Personnel exiting the exclusion zone performed a boot wash and glove removal to limit carrying any potentially contaminated material from the area. All equipment used during stream and groundwater sampling was cleaned following procedures contained in the QAPjP.

The submersible pump used in the redevelopment of monitoring wells IT-1A, MW-23, and MW-25 was decontaminated prior to use in each well. The exterior of the pump and tubing was washed with a detergent solution and rinsed with deionized water. The interior of the pump and tubing was flushed for five minutes with municipal tap water by operating the pump in a bucket which received a constant flow of water.

Equipment used in the collection of ground water samples with the Geoprobe was either washed and rinsed prior to each use as specified in the Work Plan supplement (WWES, 1992) or was obtained new and used only once, then discarded.

3.8 Potentially Contaminated Materials

Potentially contaminated materials were generated from five sources during the RFI. Personal protective equipment, decontamination materials and solutions, soil-cuttings, sampling devices and monitoring well purge water were handled as potentially contaminated waste. Personal protective equipment used in areas of known or suspected contamination was contained in 55 gallon steel drums with lids and rings and stored in the former Waste Water Treatment Plant (WWTP) on-site. Plastic sheeting used as ground cover under decontamination activities was similarly contained. Spent decontamination solution and monitoring well purge water was collected as generated and transferred to 500 gallon plastic holding tanks staged inside the WWTP. Soil cuttings generated during soil boring installation and Geoprobe soil sampling were placed in 55 gallon steel drums with lids and rings. Acrylic soil sampling tubes and tubing used for ground water sampling with the Geoprobe were similarly contained. All cuttings drums were clearly labelled with contents and source identification and staged on pallets in the southwest corner of the facility parking area. A petition to the Indiana Department of Environmental Management (IDEM) for Special Waste Classification of the cuttings is pending approval. All materials generated have been or will be properly disposed of in accordance with applicable state and federal regulations.

3.9 Quality Assurance/Quality Control (QA/QC)

QA/QC procedures were followed in accordance with the QAPjP, the October 12, 1992 Work Plan and the December 28, 1992 Work Plan supplement (WWES, 1992). A discussion of QA/QC sample results is located in Section 4.7.

3.10 Contract Laboratory

All analytical work, with the exception of field determinations of water quality parameters, soil gas analyses, and Geoprobe ground water screening analyses was performed by Southwest Laboratories of Oklahoma, Incorporated, 1700 West Albany, Suite C, Broken Arrow, Oklahoma, 74012. All work was conducted in accordance with the laboratory QAPjP approved by U.S. EPA Region V for the RFI.

3.11 Subcontractors

The soil gas sampling and analysis, ground water screening sampling and analysis, and ground water Geoprobe sampling were performed by GeoTrace Incorporated, P.O. Box 1243, Mount Vernon, Illinois, 62864.

Soil boring and monitoring well installation was performed by Environmental Drilling Services Incorporated, R.R. #1, State Road 59, Carbon, Indiana, 47837.

Surveying was performed by Kevin Potter, RLS & PE, P.O. Box 5982, Bloomington, Indiana, 47407.

Aerial photography was provided by Accu-Air Surveys Incorporated, 1220 A Avenue, Seymour, Indiana, 47274.

4.0 **RESULTS**

4.1 Hydrogeology

4.1.1 Geologic Cross Sections

Soil boring data (Appendix D) were used to prepare three geologic cross sections of the of the area (Sheets 4A and 4B). Locations of sections are shown on Sheet 3. Cross section A-B-C-E extends from MW-20 at the north end of the site to PGP-11 at the south and is oriented roughly parallel to the direction of ground water flow in the shallow sand unit (Unit B). Cross section B-C-D extends from MW-3 to IT-3 and is oriented roughly along the storm sewer alignment. Section F-G traverses the south end of the study area (south of the site), oriented west to east across Forsythe Street. Cross sections show the location of soil samples selected for analysis, well screen intervals, and ground water elevations.

The soil boring data generated by this RFI largely to confirm previous interpretations of site geology. Surficial soil materials (herein labeled as Unit A) consist of yellow brown silt loam or loam (silty clay or sandy clay) which ranges in thickness from about 3 to 8 feet. Unit A is underlain by the upper sand unit, Unit B, which appears to be continuous beneath the property and immediate surrounding area. The unit is saturated in the basal part, and the thickness of the

saturated zone varies spatially from about 4 feet to about 15 feet. Generally the saturated zone is thickest in the northern portion of the property, and thinner south of the main facility building. The unit is composed primarily of stratified fine to coarse sand, and sandy gravel. As shown on Sheet 4A, the unit grows progressively thinner southward. At location PGP-11, ground water screening sample SGP-19 was collected and no target compounds were detected (Section 3.6.4.2.1). An attempt to collect a ground water sample of sufficient volume for CLP analysis (Section 3.6.4.2.2) was unsuccessful. This suggests that the thickness saturated zone has diminished southward to the extent that insufficient water was available for sample collection by approved methods.

Unit B is underlain by a dense, gray glacial till unit (Unit C) of loam texture. At locations MW-23 and MW-25 this unit was determined to be 23 to 26 feet in thickness (Sheet 4B). The till unit serves as a confining bed between ground water zones in Units B above, and Unit D below. Unit D, as sampled at MW-23 and MW-25 consists of medium to coarse sand and loamy sand. The unit is 17 to about 20 feet in thickness. The base of Unit D occurs at an elevation of about 670 feet MSL. The unit is underlain another loam till.

4.1.2 Ground Water Flow

Ground water flow direction was determined from water level measurements in monitoring wells, as summarized in Table 1. Contours showing the configuration of the potentiometric surface in Unit B on March 25, 1992 and February 12, 1993 are provided in Figures 10, and 11, respectively. Potentiometric contours in Unit D on the same dates are shown on Figures 12 and 13. Table 1 and Figure 10 also show water level measurements obtained in storm sewer manholes south of the main facility building.

The March 25 Unit B data (Figure 10) appear to represent a relatively low ground water stage, probably related to the relatively dry 1991-1992 winter months. Water level at MW-9, for example, was about four feet lower than that observed by IT in May, 1985 (Figure 6), but water levels in the southern portion of the property are more comparable to the IT data. Ground water levels appeared to be slightly lower than water levels in the storm sewer drainage system, as measured at the north and south storm sewer manholes, (Figure 10).

On June 2, 1992 ground water levels in Unit B were higher (Table 1), and again a south and southeast ground water gradient was observed. Water levels in the northern portion of the site

were about 1.0 to 1.5 feet higher than in March, 1992, but wells south of the main facility building showed a lesser increase. Ground water levels recorded on February 2, 1993 were higher than the June, 1992 levels, and again a south-southeasterly ground water flow direction was evident (Figure 11).

During both the March and June, 1992 monitoring, significant downward vertical hydraulic gradients were observed at the three paired (Unit B/D) monitoring well clusters. Between the March and June measurement events, hydraulic heads decreased slightly in the Unit D wells (Table 1), resulting in a larger downward vertical gradient observed in June than in March. During the February, 1993 monitoring, a slight upward vertical hydraulic gradient was observed. The observed reversal in vertical gradient direction is interpreted as the result of increased hydraulic head in the Unit D wells.

The March, 1992 water level observations suggest that, at times, ground water elevations in Unit B are below the elevation of water flow within the storm sewer drainage system. At these times, the storm sewer is incapable of performing as a ground water intercept, as suggested by previous investigations, and as discussed in Section 2.5. Boring log data (Appendix D) suggest that in the storm sewer segment between MW-12 and IT-3, about four to seven feet of saturated Unit B sand occurs below the bottom of the storm sewer pipe. At higher ground water stages, the storm sewer may indeed act as a partial ground water intercept. Water levels recorded after February, 1992 consistently show the ground water potentiometric surface at a higher elevation than the storm sewer invert (Table 1). Limited data on water levels within the storm sewer suggest that the ground water potentiometric surface may exist at an elevation higher than that of the water within the storm sewer.

Hurricane Creek probably acts as a ground water sink south of the former Amphenol Facility, intercepting ground water flowing south-southeast from the facility. Unit B ground water elevations beneath the facility decrease from approximately 722 feet MSL at MW-20 to approximately 719 feet MSL at IT-3. The USGS Topographic Quadrangle map (Franklin, Indiana) indicates that Hurricane Creek lies just below 720 feet MSL.

4.2 Soil Gas

A soil gas survey was conducted at the site in January, 1992. The objectives of the survey were to provide preliminary assessment of the extent of VOC contamination at the site and to investigate the potential residual soil contamination in product/waste areas and near the sewer

lines. Results of the soil gas survey were presented to Region V U.S. EPA in a technical memorandum dated April 8, 1992, and included in this report as Appendix G. Evaluation of the soil gas data resulted in the delineation of two VOC plumes at the site (Figure 5 and 6, Appendix G). Maximum VOC concentrations in soil gas were found near that location where the storm sewer crosses under the old sanitary sewer. Decreasing VOC concentrations in all directions from the sewer line suggested that the sewer was a line source for contaminant release. A separate PCE plume was detected in soil gas at the southwest corner of the facility parking lot. It was suggested in the soil gas technical memorandum that this plume may be the result of a surface-release of PCE at or near the southwest corner of the pavement.

4.3 Applicable or Relevant and Appropriate Requirements

Analytical results for soil, surface sediment, surface water and ground water are discussed in the following sections. Results are compared to Applicable or Relevant and Appropriate Requirements (ARARs) as tabulated in Table 11. ARARs for soil and surface sediment are calculated Preliminary Remediation Goals (PRGs) (Section 5.0). ARARs for waters are PRGs, Safe Drinking Water Act Maximum Contaminant Levels (MCLs) and MCL Goals (MCLGs), also included in Table 11. Analytical data are presented in the following sections. Results which exceed any ARAR values are shaded in the data tabulations.

4.4 Soil Borings

Soil samples were collected from borings installed around the former Amphenol facility (Section 3.5). Analyses were performed for VOC and inorganic parameters listed in Appendix I. Soil analytical results are summarized in Table 3. Laboratory analytical reports are included in Appendix J.

4.4.1 Upgradient

Subsurface soil conditions upgradient from the former Amphenol facility were assessed by analyzing soil samples obtained during drilling and installation of monitoring wells MW-20 and MW-26 (Sheet 3). Soil samples were obtained from selected depth intervals as shown in Table 2. Sampling procedures and analytical parameters are discussed in Section 3.0.

No VOCs were detected at levels above PRGs in upgradient soils. Three metals (arsenic, beryllium and cobalt) were reported at levels exceeding PRGs. All concentrations are, however,

well within background ranges for soils as reported by Dragun (1991). These elements are determined to be naturally occurring in upgradient soils, and unrelated to the former Amphenol facility.

4.4.2 Plating Room

Soil conditions in the vicinity of the former plating room were evaluated by analyzing soil samples collected from soil borings SB-8, SB-9, and MW-21 (Sheet 3). Soil samples were obtained from selected depth intervals as shown in Table 2. Sampling procedures and analytical parameters are discussed in Section 3.0.

Arsenic, beryllium, cobalt and PCE were detected in soils near the former plating room at concentrations exceeding the PRGs for these parameters. Arsenic, beryllium and cobalt, present at concentrations similar to those found in soils across the site, and within reported background levels (Dragun, 1991), are determined to be present as a result of naturally occurring processes. As discussed in the plume delineation Technical Memorandum (Appendix B), VOCs detected in this area (Table 3) are attributed to residual contamination from the former plating room.

4.4.3 Sewer Lines

Subsurface soil conditions along the sewer lines south of the former Amphenol facility were investigated by analyzing soil samples collected from soil borings SB-6, SB-7, and MW-22 (Sheet 3). Soil samples were obtained from selected depth intervals as shown in Table 2. Sampling procedures and analytical parameters are discussed in Section 3.0.

PCE was detected at concentrations exceeding the PRG in samples from MW-22 (17-19 feet) and SB-7 (16-18 feet). These depths correspond to the top of the saturated zone. Soil samples collected from shallower intervals in these borings contained no VOCs in concentrations exceeding PRGs. The presence of PCE in saturated soil at depth, beneath relatively uncontaminated, unsaturated soil indicates PCE has migrated laterally through the soil to this area, most likely carried in the ground water.

Arsenic, beryllium and cobalt were reported at concentrations exceeding PRGs in soil samples collected from borings MW-22, SB-6, and SB-7. However, all concentrations are within background levels as reported by Dragun (1991), and are similar to values reported throughout

the RFI. Consequently, the occurrence of these elements at the reported concentrations is considered a natural phenomenon, unrelated to the former Amphenol facility.

4.4.4 Southwest Corner

Soil conditions beneath the southwest corner of the site were evaluated by analyzing soil samples collected from soil boring MW-27 (Sheet 3). Results of the soil gas survey indicated the presence of PCE in this area (Appendix G). Samples were collected from depths of 13-15 feet and 21-23 feet in boring MW-27. Analytical results are included in Table 3.

PCE was detected at concentrations well above the PRG in the shallow soil sample. This sample was collected at the top of the saturated portion of Unit B (Figure 4A). PCE was also detected in the deeper sample, but at a concentration below the PRGs.

4.4.5 RCRA Storage Area

A fenced, roofed enclosure located on the west site of the building was identified in the IT Work Plan (IT, 1988) as a former RCRA storage area. Soil boring SB-5 (Sheet 3) was installed adjacent to the enclosure to evaluate potential residual contamination from releases that may have occurred at the storage area. An analytical soil sample for VOCs, total metals, total and amenable cyanide and analyses was collected at two feet below the surface. Analytical results are summarized in Table 3. Arsenic, beryllium and cobalt were the only parameters detected at concentrations exceeding PRGs. Arsenic, beryllium and cobalt were also detected in soil collected at all other soil borings, at concentrations similar to those reported at SB-5 (Table 3). Dragun (1991) reported average background levels in Indiana soils ranging from 2.0 to 15 ppm for arsenic, 0 to 2.0 ppm for beryllium, and from 3.0 to 15 ppm for cobalt. The reported concentrations of arsenic, beryllium and cobalt at SB-5 are within these background values, and are interpreted as naturally occurring background levels, unrelated to the former RCRA storage area.

4.4.6 Cyanide Overflow Tank

Soil samples were collected from two soil borings installed adjacent to an in-ground concrete tank which had been previously used to store excess cyanide solution. The tank is rectangular in shape, measuring approximately six feet in width, eight feet in length, and nine feet deep. Samples were taken from soil borings SB-1 and SB-2 (see Sheet 3) from depths of 1.0 to 3.0 feet

below the bottom of the tank. Samples were analyzed for total metals, total cyanide, amenable cyanide and VOCs. Analytical results are summarized in Table 3.

The reported concentrations of arsenic, beryllium and cobalt exceed the respective PRGs for these elements. As all concentrations are well within background ranges as reported by Dracun (1991), and are similar to values reported elsewhere across the site, these levels interpreted as naturally occurring background concentrations and are determined not to be related to the cyanide overflow tank.

4.4.7 Unit C Aquitard

Analytical soil samples from the Unit C aquitard (Sheet 4A) were collected from borings MW-23 and MW-25 (Sheet 3). Sample intervals are given in Table 2, and analytical results are included in Table 3.

No VOCs were detected in excess of PRGs in Unit C soils. Arsenic, beryllium and cobalt were reported at levels exceeding PRGs. All reported concentrations are within background levels for soils as reported by Dracun (1991), and are comparable to concentrations found throughout the RFI. Consequently, the concentrations reported in samples from Unit C are determined to be naturally occurring background levels, unrelated to the former Amphenol facility.

4.4.8 Extent of VOC Contamination

The areal extent of VOC contamination in soils is shown in Sheets 5A and 5B. Sheet 5A shows total VOC concentration in soil samples collected between 0 and 12 feet below the surface. Sheet 5B shows total VOCs in soil samples from below 12 feet below the surface. VOC soil concentrations are much higher below 12 feet, at the approximate level of the top of the saturated zone.

4.5 Ground Water

Ground water quality was determined by collecting samples from permanent monitoring wells on-site and from temporary sampling points established both on- and off-site with the Geoprobe apparatus (Section 3.5). Sampling locations are shown on Sheet 3. Analyses were performed for VOCs, inorganics, and Appendix IX parameters as listed in Appendix I of this report.

Table 8 presents a summary of analytical results, showing all reported detections. Parameters listed in Appendix I but excluded from Table 8 were not detected in ground water samples collected during the RFI. Laboratory data reports are incorporated into this report as Appendix J.

4.5.1 Upgradient Shallow Aquifer

Ground water quality in the upgradient portion of the shallow (Unit B) aquifer was evaluated by analyzing samples collected from monitoring wells MW-9, MW-20 and MW-26 (Sheet 3). These locations are verified as upgradient based on interpretation of ground water flow direction using ground water levels as discussed in Section 4.1.2.

Concentrations of aluminum, beryllium, cobalt, iron, lead and manganese in upgradient ground waters were reported at levels exceeding the ARARs for these elements. These samples were collected unfiltered. The effect of filtration may be evaluated by comparison of results of filtered and unfiltered samples collected from monitoring wells MW-12 and MW-22 (Table 8). Analyses of cobalt and lead indicate that filtration of these samples reduced the concentration of these elements to below detectable limits. This suggests that element concentrations in excess of ARARs at the upgradient wells are derived from suspended solids (from native soil) in the unfiltered samples. The natural occurrence of these elements in soil was discussed in Section 4.4.

Detections of TCA (9 ug/l) and TCE (2 ug/l, estimated) in monitoring well MW-9 are consistent with results of previous sampling as reported by IT (1988) (see Appendix A, Table A-1). The presence of VOCs in ground water upgradient of the site has also been reported by ATEC (1984b) (Appendix A, Table A-1, wells MW-4, -7, -8). The current data indicate that VOC concentrations at MW-9 diminished significantly during the five year sampling hiatus. As specified in the Consent Order, the VOC concentrations reported in the upgradient wells are adopted as background levels for VOCs for the purpose of delineating the ground water VOC plume at this site.

4.5.2 Plating Room

Ground water conditions in the vicinity of the former plating room were assessed through analysis of ground water samples collected from monitoring wells MW-3 and MW-21 (Sheet 3).

Samples were collected for VOCs, total metals, total cyanide and amenable cyanide during ground water sampling round one.

Concentrations of six metals and two VOCs in ground water exceeded PRGs, as shown in Table 8. As discussed in the technical memorandum on Plume Delineation (Appendix B), VOCs in ground water at MW-3 and MW-21 are attributed to residual contamination associated with the former plating room. Of the six metals, arsenic is reported at a concentration below the regulatory MCL, and the remaining five (aluminum, cobalt, iron, lead and manganese), while present at levels greater than their respective ARARs, were found in similar concentrations at nearly all locations sampled (see Table 8). Consequently, metals concentrations reported for ground water at monitoring wells MW-3 and MW-21 are considered to be normal background levels.

4.5.3 Sewer Lines

Ground water quality in the vicinity of the storm and sanitary sewer lines was evaluated by analyzing samples collected from monitoring wells MW-12, MW-22, MW-30, IT-2, and IT-3 (Sheet 3). Samples were collected from MW-12, MW-22, IT-2 and IT-3 three times during the RFI (Section 3.6.4). Well MW-30 was installed after sampling round two, and was sampled once during sampling round three.

PCE, TCA, and TCE were consistently detected in wells along the sewer lines at concentrations exceeding ARARs or site background levels (Section 4.4.1). These data indicate that ground water in the vicinity of the storm sewer has been impacted by VOCs. The highest concentrations were recorded in samples from MW-12 and MW-22, suggesting that the damaged old sanitary sewer (Section 2.3.2) was a primary source of VOC releases.

Concentrations of aluminum, beryllium, cobalt, iron, lead, manganese, and nickel in unfiltered samples were reported in excess of ARARs. The effect of filtration may be evaluated by comparison of results of filtered and unfiltered samples collected from monitoring wells MW-12 and MW-22 (Table 8). Analyses of cobalt and lead indicate that filtration of these samples reduced the concentration of these elements to below detectable limits. This suggests that element concentrations in excess of ARARs at the upgradient wells may be the result of dissolution of suspended solids (derived from native soil) in the unfiltered samples. The natural occurrence of these elements in soil was discussed in Section 4.3.

Historic analytical data for monitoring wells IT-2 and MW-12 (Appendix A, Table A-1) were used to produce plots of concentration versus time (Figures 14a and 14b). In general, the plots show ground water VOC concentrations increasing through 1986, then decreasing to the levels observed during the RFI. The depressions in PCE and TCA concentrations in MW-12, seen in the August 1986 sample, are unexplained.

4.5.4 Southwest Parking Lot Corner

Ground water quality beneath the southwest corner of the facility was assessed by analyzing samples collected from monitoring wells MW-27, MW-28 and MW-29 (Sheet 3). These wells were installed after sampling round two, and were sampled once during sampling round three.

PCE was detected at concentrations in excess of ARARs in all three wells (Table 8). Elevated TCE levels were reported at MW-28 and MW-29. TCA at MW-28 exceeded the ARAR, and at MW-27 and MW-29, TCA concentrations exceeded site background levels. PCE concentrations decrease from MW-27, toward MW-28 and MW-29.

4.5.5 Off-site Geoprobe Samples

Ground water quality south of the former Amphenol site was investigated by analysis of ground water samples collected from the Unit B aquifer with the Geoprobe. Samples were obtained from points PGP-1 through PGP-4, and PGP-6 through PGP-10 (Sheet 3) during sampling round three.

VOCs were reported at concentrations exceeding ARARs at PGP-4S, -4D, -6, -7, -8, and -9. Concentrations of TCA exceeding background were reported at PGP-6 through -10. Concentrations of 1,2-DCE exceeding background were reported at PGP-6 (Table 8). Locations PGP-4S and PGP-4D correspond to the upper and lower portions, respectively, of the saturated zone at MW-12. Samples were collected from PGP-4S and PGP-4D to compare with results from samples from MW-12 (Section 4.6).

Elevated levels of VOCs at PGP-3, -6, -7, -8, -9, and -10 indicate VOCs may have migrated south from the site along a line approximated by the location of Forsythe Street. The most likely avenue for this pattern of migration is a municipal sanitary sewer lying directly beneath Forsythe Street (Sheet 3).

4.5.6 Unit D Aquifer

Ground water quality in the deep (Unit D) aquifer was assessed by analyzing samples collected from monitoring wells MW-23, MW-25, and IT-1A (Sheet 3). Samples were collected from these wells during sampling rounds one (March, 1992) and three (February, 1993). Between sampling events, these wells were redeveloped as discussed in Section 3.6.4.1.

Concentrations of aluminum, arsenic, beryllium, cobalt, iron, lead, and manganese in deep ground waters were reported in excess of ARARs for these elements. These samples were collected unfiltered. As discussed in Section 4.5.1, the reported concentrations are likely the result of the dissolution of suspended solids naturally containing sufficient amounts of these elements to yield the observed concentrations.

Volatile organic compounds PCE and TCE were detected during sampling round one at concentrations exceeding ARARs and site background levels. Results of samples collected during round three, after extensive well purging, indicate generally reduced VOC levels. The only confirmed detection was TCE at MW-25, reported at 11 ug/l. Other results were either estimated (13 ug/l, MW-23) or reported as not-detected. These results suggest that contaminants in Unit D are present as a result of carry down during previous well installation, and are not an indication of general aquifer contamination.

4.6 Surface Water and Surface Sediment

Surface water and surface sediment conditions were investigated by analyzing samples collected from five locations around the site (Figure 9). Analytical results for surface sediment samples are summarized in Table 6. Laboratory analytical reports are included in Appendix J. Concentrations of arsenic, beryllium and cobalt are reported above PRGs for those metals. However, all concentrations are within background ranges (Dragun, 1991) and are therefore interpreted as naturally occurring. Surface water analytical data are summarized in Table 5. Laboratory analytical reports are included in Appendix J. Samples collected during the first round of surface water sampling, conducted in February, 1992, contained no elevated levels of VOCs or cyanide. Samples were collected from surface water sampling point SW-02 again in July, 1992 (round two) and February, 1993 (round three). Results from the July, 1992 sampling reveal elevated levels of arsenic, beryllium, PCE, TCA and TCE. Arsenic and beryllium are derived from the dissolution of soils and sediments containing these elements as discussed earlier. PCE, TCA and TCE are likely present as the result of the storm sewer acting as a ground

water intercept, transmitting ground water from the site during periods of relatively high ground water levels as discussed in Section 4.7.3.

4.7 Quality Assurance/Quality Control (QA/QC)

4.7.1 QA/QC Samples and Deviations from Plan Documents

Sampling and QA/QC methodologies for this RFI come from five previously submitted and approved sources: the IT Work Plan (1988), the Consent Order, the QAPjP documents (approved May, 1991), the October, 1992 Work Plan for additional site work, and the December, 1992 supplement to the October Work Plan. As a result of unforeseen conditions during site work, opportunities to improve or enhance data collection, and/or equipment limitations, a number of deviations from the above noted plans occurred. Sampling deviations have been discussed elsewhere in the report under sampling methods (Appendix G, Section 3.6.2, Section 3.6.3, Section 3.6.4.1).

When collecting soil samples from borings in the winter of 1992, it was found that due to difficult drilling conditions, often only one or two soil samples could be collected daily. Rather than go to the expense of running sets of QA/QC samples with every daily set of samples, equipment blanks and duplicate samples were collected at a rate of one in 10 samples. Thus there were a total of 30 soil boring samples, three equipment blanks and three duplicates. A matrix spike and duplicate was performed for VOCs. A second matrix spike and duplicate sample should also have been performed, but was not. This omission is not perceived to have materially affected the results or conclusions of this RFI.

For the five surface water and sediment samples, a blank and a duplicate were performed with the sediment samples. A duplicate, a matrix spike and a matrix spike duplicate were performed with the surface water. No equipment blank was performed with the surface water sample because sampling equipment was not used in collecting the samples. A trip blank for VOCs did accompany the sample shipment. For the second round of sampling (to determine if VOCs were present when ground water levels were high on site), the surface water sample duplicate was not performed. For the third round of sampling, a duplicate, a matrix spike and a matrix spike duplicate were performed with the surface water sample. An equipment blank (DIW in a sample container) was also collected.

For the thirteen first-round ground water samples, three equipment blanks, three duplicates and two matrix spikes and matrix spike duplicates were performed. Samples from MW-12 and MW-22 were analyzed for Appendix IX analytes as required in the Consent Order, and for total and dissolved metals. Samples from MW-26 had to be collected on three additional occasions for total and amenable cyanide because sample containers broke during shipment. An equipment blank was collected and sent with the second sample. During the second sampling round, an equipment blank was collected with the four analytical samples. During the third round of ground water sampling, twelve samples were collected, plus two equipment blanks, two duplicates, a matrix spike and a matrix spike duplicate. For the Geoprobe samples, sixteen analytical samples were collected, along with four equipment blanks, three duplicates, two matrix spikes and two matrix spike duplicates.

4.7.2 QA/QC Audits

QA/QC audits were performed during routine inspections of the field work. These were performed on 1/30/92 during the soil gas survey, during 2/13/92 while installing monitoring wells, and on 3/6/92 while sampling ground water. The audits covered sampling techniques, QA/QC samples, decontamination, recordkeeping and sample condition. All findings were entered in a bound field log book, and problems were discussed with the field crew. In addition, the Project Manager checked approximately 70 percent of the sample shipments going out to insure proper recordkeeping, sample condition, sample preservation, and packing.

4.7.3 Laboratory Data Quality

Data from the first round of sampling were validated by the WW Engineering & Science Grand Rapids, Michigan Office. Data from the second and third round of sampling were validated by HMM Associates, of Concord Massachusetts, a sister company of WW Engineering & Science. Validation packages from these sources are included in Appendix K.

The following problems were noted in the first round:

- 1) Although matrix spike and matrix spike duplicate samples were submitted for analysis for Appendix IX SVOCs, dioxin, furans, phenols, PCBs and pesticides, the sample was not run by the laboratory, and the results are estimated. However, there were no positive results for any of these analytes, and no reasons to believe that they ever existed at this site.

- 2) The data were validated by groups, and not every group had an associated trip blank, blank or duplicate, although the QA/QC sample may have been sent in another shipment that day. Data were flagged as estimated when a blank or duplicate result was not observed with that group.
- 3) Some trip blanks contained acetone, PCE, and 1,2-dichloropropane. Data for these compounds had to be estimated.

The following problems were noted in the second round:

- 1) Matrix spike results were out of control for a number of metals.
- 2) Common, nonhazardous analytes were found in a number of field blanks. However, mercury was found in one field blank at a concentration of 0.53 ug/L.
- 3) Acetone was found at low levels in several method blanks trip blanks, as was chloroform. One field blank and trip blank set contained appreciable levels of acetone, 2-butanone, 1,2-dichloropropane, methylene chloride, PCE, toluene and xylene. With the exception of PCE, none of these compounds was among the primary VOCs of concern.

4.8 Contaminant Plume Delineation

Contaminant plume delineation was performed based on ground water analytical data as presented in Section 4.5. Isoconcentration maps for DCA, PCE, TCA, and TCE in ground water samples collected in March, 1993 are shown in Sheets 6A, 6B, 6C, and 6D, respectively. An isoconcentration map for total VOCs in ground water is shown in Sheet 6E.

4.8.1 Unit B Aquifer

DCA was not detected above 5 ug/l north of the facility (Table 8). The ARAR for DCA is 1010 ug/l (Table 11). Plume delineation (Figure 5A) is based on the non-detect level of 5 ug/l. DCA concentrations in excess of 5 ug/l in ground water were consistently found along the sewer lines. The elongation of the isoconcentration contours eastward along the south edge of the site indicates that DCA has been carried along the storm sewer alignment. Similar elongation of the plume southward from the site along Forsythe Street indicates the municipal sanitary sewer has acted as a source of DCA contamination of ground water in this area.

The ARAR for PCE is 1.43 ug/l (Table 11). PCE was detected in upgradient monitoring well MW-26 at 3 ug/l (Table 8). Plume delineation was accomplished using 3 ug/l as a background level for PCE at the site (Figure 5B). PCE concentrations in excess of 3 ug/l were found west and south of the facility, roughly following the storm sewer and sanitary sewer lines. Off-site PCE ground water impacts are indicated at PGP-8 and IT-2 (Figure 5B).

TCA was detected in upgradient monitoring well MW-9 at 9 ug/l (Table 8). The ARAR for TCA is 200 ug/l (Table 11). A site background value of 9 ug/l for TCE was adopted for plume delineation (Figure 5C). Elevated TCA concentrations were observed in ground water south of the facility extending from the southwest parking lot corner eastward and southward along the sewer lines. Concentrations exceeding site background were observed off-site to the east and south along Forsythe Street. Concentrations exceeding background at PGP-6, -7 and -10 are upgradient from, and probably not related to the plume from the former Amphenol site.

TCE was detected at 2 ug/l in upgradient monitoring well MW-9. The ARAR is 1.43 ug/l. Plume delineation was performed using 2 ug/l as the background TCE concentration at the site (Figure 5D). Elevated TCE concentrations south and southeast of the site indicate that the storm sewer and sanitary sewer may have acted as containment migration pathways. Local exceedances at PGP-6 and -7 are upgradient from, and probably not related to the former Amphenol site.

4.8.2 Storm Sewer

The potential for the storm sewer to act as a preferential path for contaminant migration was evaluated by monitoring water levels and collecting water samples during periods of relatively high and relatively low ground water levels. Ground water levels are shown in Table 1. Storm sewer and monitoring well elevation data are given in Appendix C.

During ground water sampling round one, ground water levels were found to be below the level of the storm sewer invert, suggesting that the storm sewer was not acting as a ground water intercept. Surface water samples collected from the storm sewer outfall during sampling round one (SW-02, Figure 9) contained no VOC or cyanide concentrations above detectable limits (Table 5), substantiating the interpretation that the storm sewer was not acting as a ground water intercept. During ground water sampling rounds two and three, ground water levels were found at elevations above that of the storm sewer invert, and water levels recorded in the storm sewer during sampling round two (see Table 1) were below the elevation of the ground water,

suggesting that the storm sewer trench may be acting as a ground water intercept. Water samples collected from the storm sewer outfall (SW-02, Figure 9) during sampling rounds two and three contained detectable levels of PCE, TCA and TCE (see Table 5). These detections indicate that the storm sewer is intercepting ground water beneath the site and transmitting it to the outfall at surface water sampling point SW-02.

4.8.3 Sanitary Sewer

A municipal sanitary sewer exists beneath the site and off-site to the south (Sheet 3). The on-site segment of the sewer line is discussed in Section 2.3.2. City of Franklin personnel reported that the off-site portion of the sewer from the site to the vicinity of Ross Court is 8-inch Vitrified Clay Pipe (VCP) with tarred joints, and that the pipe enlarges to 12-inch VCP at that point (Littleton, 1993). The sewer pipe is reportedly 7 to 8 feet below the ground surface.

VOCs detected in ground water south of the site along Forsythe Street (Section 4.8.1) suggest that the sanitary sewer has acted as a secondary contamination source. Figures 5A, 5C and 5D show DCA, TCA and TCE plumes, respectively, extending to sampling point PGP-9.

5.0 **QUALITATIVE RISK ASSESSMENT**

5.1 Introduction

In this section, data collected during the 1992 and 1993 RFI/CMS field investigations (described in Sections 1.0 to 4.0) are evaluated to determine the potential for site-related chemicals to present unacceptable human health and environmental risks. This qualitative Risk Assessment (RA) was prepared in accordance with the "Qualitative Risk Assessment" procedures presented in Section 4.5 of the IT Work Plan for the site (IT, 1988). This RA is designed to qualitatively determine if potential risks exist and, if so, whether additional investigations and evaluations, ongoing monitoring, or no further action is required to address the potential risks. If the qualitative RA adequately demonstrates that the site does not pose an unacceptable risk to human health and the environment, then a quantitative RA is not necessary. Conversely, if the qualitative RA indicates that a potential risk may be present, additional investigations may be necessary and may include the completion of a more formal, quantitative RA. In this latter case, the qualitative RA can be used to focus additional investigations towards the areas of greatest concern.

As specified in Section 4.5 of the IT Work Plan, this qualitative RA will combine an evaluation of the following:

- Hazard Identification
- Exposure Assessment
- Toxicity Assessment
- Risk Characterization

Based on the above, this RA will result in the recommendation of one of the following for the site:

- Does not pose an unacceptable risk to human health and the environment and therefore does not require any additional monitoring or remedial action: Recommendation of "No Action";
- Does not pose an unacceptable risk to human health and the environment under current conditions but may pose a risk at some time in the future: Recommendation of "Monitoring";
- Poses an actual risk to human health or the environment according to the existing level of data and requires additional site-specific data collection to better define the actual or potential risk: Recommendation of "Additional Investigation or Remediation".

If compounds which present a potential human health or ecological hazard are identified, further analysis will be conducted to determine if complete or potentially complete chemical exposure pathways exist. An estimate of the significance of potential exposures will be made for any pathways determined to be currently complete or potentially complete in the future. For the latter determinations, observed chemical concentrations at points of potential human or ecological exposure will be combined with an evaluation of the potential toxic effects of the chemicals of concern, including a comparison of site data to Applicable or Relevant and Appropriate Requirements (ARARs).

5.2

Background

The former Amphenol site is located in an area of mixed commercial/industrial and residential use in the city of Franklin, Indiana. Approximately six acres of the 15-acre site is used for commercial/industrial purposes. The remainder of the site is used for farming. Land surrounding the site to the south, southeast, and southwest is used predominantly for residential purposes. Surrounding land in other directions is used predominantly for commercial and industrial purposes and agriculture. The site is unfenced.

The predominant residential area is located south and west of the site. Areas to the north and east are less densely populated and have commercial/industrial use. There are no schools or other institutions (e.g., hospitals, nursing homes) which would be occupied by sensitive sub-populations located on any of the adjacent properties. The nearest school is located approximately one-half mile south of the site, south of Hurricane Creek. The City of Franklin operates a municipal water supply well upgradient, and about one mile northeast of the site. There are no known private drinking water wells located in the residential areas downgradient from the site. Appendix L shows the area to which well information mailings were sent, and responses.

As described in Section 2.0, a storm sewer transects the site and is believed to intercept, at least in part, ground water migrating down gradient from the site. The storm sewer discharges to Hurricane Creek, a nearby surface water body flowing through Franklin. This creek is intermittent (i.e., during periods of little precipitation, the stream may have no flow). The intermittent nature of this stream likely affects its ability to support significant aquatic life. Aquatic life is considered a potential exposure target in this qualitative RA.

5.3

Hazard Identification

This step in the RA evaluates whether chemicals identified at the site could potentially produce adverse human health or ecological effects given the specifics of the site. The identification of such a hazard, if any, will trigger the need to complete other aspects of this qualitative RA. In making this determination, consideration is given to the intrinsic toxicological properties of those chemicals detected at the site, the magnitude of detected concentrations, and the existence of known or potential exposure routes.

Organic and inorganic analytical data for soil, surface water, surface sediment, and ground water are shown in Tables 3, 5, 6 and 8, respectively. Historic analytical data from the years 1984-1986 are presented in Appendix A. A summary of organic chemicals detected during the 1992 and 1993 ground water, surface water and soil sampling rounds is presented below.

Ground Water

<u>Compound</u>	<u>Range/Location of Highest Value</u>
acetone	undetect - 11 ug/L/IT-2
1,1-DCA	undetect - 817 ug/L/PGP-4
1,1-DCE	undetect - 11 ug/L/IT-3
1,2-DCE (total)	undetect - 78 ug/L/IT-2
PCE	undetect - 19,499 ug/L/MW-22
TCA	undetect - 5,400 ug/L/MW-12
TCE	undetect - 5,957 ug/L/PGP-4
4-methyl-2-pentanone	undetect - 150 ug/L/Mw-12
carbon tetrachloride	undetect - 52 ug/L/MW-28
toluene	undetect - 4 ug/L/PGP-6
methylene chloride	undetect - 2 ug/L/PGP-9/MW-24
xylene (total)	undetect - 2 ug/L/PGP-6

Soil/Sediment

acetone	undetect - 35 ug/kg/SB-2 (10')
2 butanone	undetect - 390 ug/kg/MW-27 (15')
chloroform	undetect - 3 ug/kg/MW-27 (23')
methylene chloride	undetect - 1,500 ug/kg/MW-23 (21.5')
PCE	undetect - 120,000 ug/kg/MW-22 (19')
TCA	undetect - 750 ug/kg/MW-21 (18')
TCE	undetect - 5,300 ug/kg/MW-21 (18')
toluene	undetect - 5 ug/kg/MW-20 (12')
xylene (total)	undetect - 2 ug/kg/MW-27 (23')

Surface Water

1,1-DCA	undetect - 3 ug/L/SW-02
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PCE	undetect - 86 ug/L/SW-02
toluene	undetect - 1 ug/L/SW-01
TCA	undetect - 35 ug/L/SW-02
TCE	undetect - 66 ug/L/SW-02

Total cyanide and cyanide amenable to chlorination was found to occur in deep soil samples, but not in surface or ground water samples.

A variety of metals was detected in soil and water samples. Among these are aluminum, arsenic, beryllium, cobalt, iron lead, manganese and nickel. Aluminum and iron are considered essential human nutrients are not known to present unacceptable health risks at the concentrations observed at this site. The rest of the metals listed above were found above ARARs as total metals in ground water samples, but not in the dissolved metals samples (Table 8). The metals arsenic, beryllium and cobalt found in soil did not vary significantly across the site, did not vary significantly with depth, and had no observed "hot spots". The levels of metals observed in soil and ground water samples are interpreted as typical of site background levels. Accordingly, metals will not be considered further in this RA.

Several of the detected organic compounds may present potential human health effects following significant exposures, and their presence in soils and ground water suggests that a potentially significant exposure could occur.

The chemicals detected have been evaluated by U.S. EPA for their potential to cause toxicity to aquatic organisms. The presence of potentially site-related chemicals in surface water and sediment could present a potential hazard to both aquatic and terrestrial species residing in or near this creek.

The detection of chemicals known to exhibit potential human health and environmental effects in on-site and nearby off-site environmental media serves as an indication that a potential hazard exists at the site. Conditions are such that an evaluation of this hazard is warranted, especially in light of potential off-site migration of contaminants and a lack of institutional controls to limit soil or ground water exposures at off-site locations. Furthermore, data indicate that chemicals have migrated in the past, (and continue presently) via the storm sewer and sanitary sewer to areas where they could pose an ecological hazard.

All organic chemicals and total and amenable cyanide detected in ground water, soils, sediments and surface water at the site are regarded as potential chemicals of concern. These chemicals will be retained throughout this qualitative RA of the site.

5.4 Exposure Assessment

Exposure assessment involves the identification of current and potential future pathways of chemical exposure and the estimation of chemical concentrations to which populations may be exposed. The identification of relevant exposure pathways requires consideration of the nature and extent of environmental contamination and the identification of current and potential future land uses at the site. The estimation of chemical concentrations to which a receptor may be exposed is based on an evaluation of current chemical concentrations, and potential changes in concentration due to contaminant migration or attenuation due to factors such as natural degradation.

5.4.1 Contaminant Release Pathways

The chemicals identified in Section 5.3 are believed to be present due to past releases which occurred at or near manufacturing areas of the former Amphenol site. Chemicals in soils are found primarily near manufacturing areas at the site. Chemicals that were originally released presumably have migrated from these areas of release by two pathways:

- 1) the sanitary sewer, with subsequent migration into ground water through sewer joints, or;
- 2) via ground water with interception by the storm drain at the site or continued migration in ground water in a downgradient direction.

5.4.2 Environmental Fate and Transport

Given the nature of the major site contaminants, and the fact that no additional contaminants are being released, degradation and attenuation processes would almost certainly result in the reduction of potential exposure concentrations over time. As stated in the IT Work Plan, however, for the purposes of this qualitative RA, chemicals will be assumed not to attenuate or degrade in the environment. It is assumed, therefore, that potential current and future chemical

exposures would occur at concentrations currently identified in the environmental media at the site.

5.4.3 Exposed Populations

The site is currently zoned and used for industrial and agricultural purposes. Given the nature of the property and its current use, reasonably foreseeable future uses of the site are also likely to be commercial/industrial and agricultural. Residential areas adjoin the site (predominantly to the south) and, therefore, the neighboring residents are also considered a potentially exposed population under both current and future use scenarios. There are no areas occupied by sensitive sub-populations (e.g., schools, hospitals, nursing homes) adjacent or near the site. The nearest such area, a school, is located about one-half mile south of the site, and south of Hurricane Creek. There is a city park located along Hurricane Creek, just south and west of the Forsythe Street Bridge crossing. Specific exposure pathways for the commercial/industrial and agricultural uses of the site, residential use of neighboring property, and the city park and Hurricane Creek are discussed below.

5.4.3.1 Industrial/Commercial and Agricultural Uses

Worker exposures to chemicals in soils at the site could occur if worker functions involved significant outdoor activity involving excavations in areas of chemical impact. Workers could be exposed by several pathways of exposure, including incidental ingestion and dermal exposure. At this time, there is no significant outdoor work or excavating taking place on this site.

The site is located in an area served by a municipal water supply and currently there are no uses of ground water at the site. Thus, for the current worker population, the ground water exposure pathway is considered incomplete. If a future industrial occupant installs a water supply well at the site and uses ground water for process water or as a drinking water supply, direct ingestion of water and dermal exposures by workers could then be significant routes of chemical exposure.

Only a small area of the site where impacts exist is used for agricultural purposes. In addition, ground water at the site is not used for irrigation. For these reasons, it is unlikely that the current agricultural use of a portion of the site would lead to significant chemical exposure. Significant exposures could occur if agricultural use continues and if ground water is used in the future for

irrigation. Under normal farming practices, exposure of deep subsurface contaminated soil is not anticipated at any time.

5.4.3.2 Residential Use

Current and future residents could be exposed to chemicals in soils either through direct contact at the site or by migration of contaminated windblown soil. Direct ingestion and dermal absorption are considered the primary routes of exposure to contaminants in soils. Secondary pathways of exposure such as inhalation of contaminants volatilizing from soil and inhalation of airborne particulates, may also occur to nearby residents. At this site, the significance of the above pathways are limited by the fact that chemical contamination in soils generally has been identified only in the deep subsurface.

As a part of this evaluation, an inventory of potential ground water wells was undertaken. This inventory included a review of available well installation records as well as the distribution of notices requesting information on the existence of any ground water wells to residences in the downgradient area (see Appendix L). Two off-site ground water wells were visually located at residences in the area of potential ground water impact. These were:

- 1) a hand pump located at a residence at 990 Hamilton Avenue adjacent to the site (to the west of the location of monitoring well MW-12); and
- 2) an apparently existing well at a residence located at 451 Forsythe Street, approximately one-quarter mile south of the site.

According to the site owner, the first well is not used. Use information on the second well was not provided by the owner, but it is reportedly used only for garden watering.

While ground water is not currently used as a drinking water source at neighboring homes, under potential future residential uses, a well could be installed at the site or on adjacent downgradient property and used for domestic purposes. The residential population could then be exposed to contaminants in ground water by ingestions, dermal absorption and inhalation. Direct ingestion of contaminants in ground water would likely be the most significant route of exposure for the on-site resident. In addition, as many of the contaminants of concern are volatile organic

compounds, inhalation of volatilized contaminants during domestic uses, such as showering also would be possible.

Human exposures to chemicals migrating off-site via the sanitary sewer could occur through backup of contaminated sewer water into homes. This is unlikely to occur since no contaminants are currently being introduced into the sewer, and the contaminated ground water is located approximately 12 to 14 feet below ground, approximately 4 to 6 feet below the sewer line. Because of constant use of the sewer by local businesses and residences, it is unlikely that the sewer line can build up concentrations of organic vapors that could enter homes.

5.4.3.3 Jack Morgan Park and Hurricane Creek

The park has several feet of frontage along Hurricane Creek, and human exposures to chemicals migrating off-site via the storm sewer and eventually to Hurricane Creek can occur. Given the intermittent nature of the creek, it is not likely to support significant aquatic life upon which a local population would rely for recreational fishing. Furthermore, the main chemicals of concern identified in surface water (VOCs) are not known to bioaccumulate significantly in aquatic organisms. For these reasons, ingestion of potentially contaminated fish or other aquatic life from this creek is not considered a major route of human exposure. Children playing in these waters could, however, come in contact with chemicals in this creek through dermal absorption, and ingestion.

5.4.4 Exposure Concentrations

See Sections 5.3 and 5.4.2.

5.5 Toxicity Assessment

In this section, published toxicological data are evaluated for those chemicals detected at the site. These data serve to evaluate the relative toxicity of site-related chemicals and to identify those chemicals having the greatest potential to produce health effects. Potential ARARs developed, in part, from this toxicological information are also presented in this chapter. These potential ARARs will be used to screen site data to identify the most significant chemicals based on toxicity and concentration.

5.5.1 RfDs and SFs

The U.S. EPA has evaluated available toxicological data for most of the chemicals detected at the site. The toxicity summaries prepared by the U.S. EPA are regularly published in several forms (including the U.S. EPA's Integrated Risk Information System (IRIS) and the Health Effects Assessment Summary Tables (HEAST)). The U.S. EPA derived RfD and SF data for chemicals detected at the site are presented in Table 12.

For carcinogens, the carcinogenic response is assumed to be a "non-threshold" effect: any exposure regardless of how small, increases the potential for developing cancer. The potential for causing a carcinogenic effect is expressed as a slope factor, which represents the upper 95% confidence limit on the linear component of the slope of the tumorigenic dose response curve. The slope factor is used in the RA to estimate the upper bound lifetime probability of developing cancer as a result of exposure to a carcinogen.

A reference dose (RfD), or reference concentration (RfC), is the most common method for expressing the potential noncarcinogenic effects resulting from chemical exposure. An RfD is defined as an estimate of a daily exposure level for humans that is likely to be without an appreciable risk of adverse health effects during the period of exposure. Safety or uncertainty factors (which are generally multiples of ten) are used to account for uncertainty in these determinations.

5.5.2 ARARs Identification

All applicable ARARs and sources used in this study are presented in Table 11.

5.5.2.1 Ground Water and Soil

The U.S. EPA has used the available human and ecological toxicity data on environmental contaminants and combined it with other information to develop standards and criteria for environmental media. These standards, referred to as Applicable or Relevant and Appropriate Requirements (ARARs), are useful as a data screen to qualitatively evaluate potential health risks. ARARs for drinking water include Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs) for drinking water. These would be appropriate as a screen for potential hazards from exposure to ground water that could potentially be used for drinking water purposes.

Contaminants detected at the site also can be compared to media-specific action levels calculated in accordance with guidance presented in "Part B, Development of Risk-based Preliminary Remediation Goals" of the Risk Assessment Guidance for Superfund (RAGS Part B) (October 1991). This document presents standard equations for determining media-specific action levels and is particularly well suited for use as an initial screen of site data. In this assessment, the PRGs developed to address potential residential uses of a site and adjoining areas (generally the most highly exposed population) were employed. The PRGs for ground water are calculated assuming consumption of ground water and inhalation of chemicals volatilizing from ground water. The PRGs for soils are developed assuming direct human contact to soils.

A third type of ARAR identified for evaluating chemicals detected in soils and ground water are RCRA Subpart S soil and ground water action levels. These action levels are calculated using standard exposure assumptions presented in draft corrective action requirements (Federal Register Vol. 55, No. 145, July 27, 1990). Action levels for ground water are calculated assuming 70-year residential ingestion exposures. Action levels for soil are calculated assuming child exposures to soil through ingestion.

5.5.2.2 Surface Water

Potential ARARs for chemicals detected in surface water include federal Ambient Water Quality Criteria (AWQC). AWQC are designed to be protective of aquatic life and are divided into acute and chronic criteria. AWQC and supporting data used to develop these criteria are presented in Quality Criteria for Water, U.S. EPA Office of Water Regulation, May 1986. For the major site-related VOCs, U.S. EPA has not produced formal AWQC, lists. Lowest observed effect levels as determined from available literature must be used.

5.6 Risk Characterization

In this section, chemical specific ARARs identified in the previous section are compared, where appropriate, to chemical concentrations detected in media potentially impacted by the site chemicals. This comparison is completed for those routes of exposure identified as being potentially significant in Section 5.4.3. Where multiple ARARs were identified (e.g., MCLs, PRGs, and RCRA Action Levels), the most stringent ARAR was used for this comparison.

In reviewing these results, it should be noted that this qualitative RA utilizes a number of assumptions concerning chemical exposures at the site. It is not intended to be an actual assessment of the potential significance of risks and is not intended to be a quantitative RA. The assessment is also not intended to model or predict exposure levels to any currently existing population.

It is important to note that under current site conditions, exposures to contaminated soils and ground water are limited. More significant exposures could only occur under other potential future uses of the site and surrounding area. Section 5.7 presents a discussion of the uncertainty involved in this qualitative RA.

5.6.1 RFI Data

Tables 3, 5, 6 and 8 show the RFI data compared to identified ARARs for soils, surface water surface sediment and ground water, respectively.

5.6.1.1 Soils

A comparison of chemicals detected in soils to potential ARARs is presented in Table 3. The volatile compound PCE was detected at levels in excess of the soil PRG in on-site soils. PCE was detected at concentrations in excess of its controlling soil ARAR (the 10 mg/kg RCRA soil action level) in a total of seven soil samples. The highest level was 120 mg/kg in sample MW-22 (collected in February 1992), which corresponds to the location of greatest ground water impact as discussed above. It should be noted that there were no exceedences of soil PRGs in samples at depths less than 12 feet. Under current conditions, therefore, it is unlikely that significant exposures to these VOC contaminated soils would occur.

Neither the soil PRGs or the RCRA soil action levels take into account the potential for contaminants to migrate from soils to ground water. However, the RFI sampling has characterized the levels of contaminants in ground water immediately below areas of contaminated soil. Because no additional contaminants are being released at the site, it is believed that the relationship between soil and ground water contamination is adequately characterized.

5.6.1.2 Surface Water

Sampling during July 1992 and February 1993 indicated the presence of four volatile organic parameters in surface water collected at location SW-02, the outfall of the storm sewer intersecting the site. These were DCA, PCE, TCA, and TCE. The concentrations of these chemicals ranged from 3 to 86 ug/l. During sampling in March 1992, none of these constituents was identified at this sampling location, but toluene was detected at a concentration of 1 ug/l in sample SW-01. SW-01 is the sample collected from the upstream location in Hurricane Creek and, therefore, is not likely an indication of any site contamination.

Cyanide was analyzed for, but not detected in any of the surface water samples.

No contaminants were detected in Hurricane Creek downstream from the storm sewer outfall, so exposure at the city park is highly unlikely. However, children playing at the storm sewer outfall into Hurricane Creek could be exposed to the volatile organic compounds TCE and PCE above ARARs by accidental ingestion.

The ARARs for water identified for this qualitative risk evaluation are, however, based on an assumption of daily residential use of water, and, therefore are not appropriate for evaluating the potential significance of the limited exposures to children playing in creek water at the outfall. A site-specific, quantitative evaluation of both the carcinogenic and noncarcinogenic risks from these exposures is provided below.

Noncarcinogenic Effects

The potential noncarcinogenic health effects resulting from exposure to TCE and PCE in surface water through incidental ingestion can be expressed by the following equation:

$$\text{Hazard Quotient} = (\text{CW} \times \text{IR} \times \text{ET} \times \text{EF} \times \text{ED}) / (\text{BW} \times \text{AT} \times \text{RfD})$$

where:

- CW = the concentration of the chemical in water, mg/l,
- IR = the incidental ingestion rate for surface water, 0.050 l/hr,
- ET = exposure time, 1 hr/day,
- EF = the exposure frequency, assumed to be 26 days per year,

ED = the exposure duration, assumed to be six years (children ages 6 to 12),
BW = the average body weight of children six to twelve, 35 kg,
AT = the averaging time in days, 6 years x 365 days/year or 2190.

Using the above equation and exposure factors, and the RfDs in Table 12, the calculated noncarcinogenic hazard quotient for incidental ingestion for PCE is 0.00084 and for TCE is 0.0011.

Children wading in the creek could also be exposed to chemicals in water through dermal uptake of chemicals. The potential noncarcinogenic health effects resulting from exposure to TCE and PCE in surface water through dermal absorption can be expressed by the following equation relating the noncarcinogenic RfD to estimated exposures:

$$\text{Hazard Quotient} = (\text{CW} \times \text{SA} \times \text{PC} \times \text{ET} \times \text{EF} \times \text{ED} \times \text{CF}) / (\text{BW} \times \text{AT} \times \text{RfD})$$

where:

CW = the concentration of the chemical in water, mg/l,
SA = the skin surface area while wading, 1,520 cm² (lower legs, forearms and hands),
PC = the dermal permeability constant (cm/hr), (0.048 for PCE and 0.016 for TCE),
ET = exposure time (1hr/day),
EF = the exposure frequency, assumed to be 26 days per year,
ED = the exposure duration, assumed to be six years (children ages 6 to 12),
BW = the average body weight of children six to twelve, 35 kg,
AT = the averaging time in days, 6 years x 365 days/year or 2190.

Using the above equation and exposure factors, and the RfDs in Table 12, the calculated noncarcinogenic hazard quotient for dermal absorption for PCE is 0.0023 and for TCE is 0.00099.

The total noncarcinogenic hazard indices from exposure to both chemicals by both pathway is 0.0053. These results indicate that potential noncarcinogenic health affects from exposure to chemicals in surface water are not expected to be significant.

Carcinogenic Effects

The potential carcinogenic health effects resulting from exposure to TCE and PCE in surface water through incidental ingestion can be expressed by the following equation relating the carcinogenic slope fact (SF) to estimated exposures:

$$\text{Excess Cancer Risks} = (\text{SF} \times \text{CW} \times \text{IR} \times \text{EF} \times \text{ED}) / (\text{BW} \times \text{AT})$$

where:

- CW = the concentration of the chemical in water, mg/l,
- IR = the incidental ingestion rate for surface water, 0.050 l/hr,
- ET = exposure time, 1hr/day,
- EF = the exposure frequency, assumed to be 26 days per year,
- ED = the exposure duration, assumed to be six years (children ages 6 to 12),
- BW = the average body weight of children six to twelve, 35 kg,
- AT = the averaging time in days, 70 years x 365 days/year or 25550 days.

Using the above equation and exposure factors, and the SFs in Table 12, the calculated excess carcinogenic risk for incidental ingestion of PCE is 3.9×10^{-8} and for TCE is 6.3×10^{-9} .

Children wading in the creek could also be exposed to chemicals in water through dermal uptake of chemicals. The potential carcinogenic health effects resulting from exposure to TCE and PCE in surface water through dermal absorption can be expressed by the following equation:

$$\text{Hazard Quotient} = (\text{SF} \times \text{CW} \times \text{SA} \times \text{PC} \times \text{ET} \times \text{EF} \times \text{ED} \times \text{CF}) / (\text{BW} \times \text{AT})$$

where:

- CW = the concentration of the chemical in water, mg/l,
- SA = the skin surface area while wading, 1520 cm² (lower legs, forearms and hands),
- PC = the dermal permeability constant (cm/hr) (0.048 for PCE and 0.016 for TCE),
- ET = exposure time (1 hr/day),
- EF = the exposure frequency, assumed to be 26 days per year,
- ED = the exposure duration, assumed to be six years (children ages 6 to 12),

BW = the average body weight of children six to twelve, 35 kg,

AT = the averaging time in days, 70 years x 365 days/year or 25550 days.

Using the above equation and exposure factors, and the RfDs in Table 12, the calculated excess carcinogenic risk for dermal absorption for PCE is 1.0×10^{-7} and for TCE 5.6×10^{-9} .

The total excess carcinogenic risk for exposure to both chemicals by both pathways is 1.5×10^{-7} . These results indicate that potential excess carcinogenic health risks resulting from exposure to chemicals in surface water are below the acceptable risk range of 10^{-4} to 10^{-6} established by U.S. EPA.

Environmental Risk

While there are no final AWQC for the protection of aquatic life for any of the above VOCs, the concentrations of each in the surface water were well below their respective acute and chronic Lowest Observed Effect Levels (LOELs) (presented in Quality Criteria for Water, U.S. EPA Office of Water Regulation, May 1986).

5.6.1.3 Sediment

Because of the potential for children to utilize Hurricane Creek, chemical concentrations observed in sediments are compared to the soils PRGs. This is a conservative assessment, as it is unlikely that children would contact sediments at the same frequency assumed by U.S. EPA for developing soil PRGs and RCRA soil action levels (daily contact over a period of years). Nevertheless, these data provide a useful initial screen of the data to identify potential human health effects.

A comparison of chemical concentrations in sediments with the potential soil ARARs is presented in Table 6. No VOCs were detected in storm sewer or Hurricane Creek sediments at concentrations in excess of their soil PRGs.

Cyanide was analyzed for, but not detected, in any sediment sample.

As shown in Table 8, some VOCs were detected in on-site monitoring wells at concentrations several orders of magnitude greater than identified ARARs. The highest concentrations were observed in monitoring wells MW-12 and MW-22. The three VOCs detected at highest concentrations were TCA (5400 ug/l), TCE (5957 ug/l), and PCE (19,499 ug/l). Each of these maximum concentrations was observed during the later (February 1993) sampling event. The MCLs (and the RCRA ground water action levels) for both TCE and PCE are 5 ug/l and the ground water PRGs for both are approximately 1 to 2 ug/l. The observed levels in MW-12 and MW-22 are several orders of magnitude in excess of these potential ARARs.

Off-site wells IT-2 and IT-3 are significantly less impacted than on-site wells. VOCs were detected at levels in excess of an ARAR in these wells during each of the recent sampling events. The greatest concentrations included: TCE at concentrations of 39 ug/l (February 1993) and 34 ug/l (March 1992) in wells IT-2 and IT-3, respectively; PCE at 5 ug/l and 8 ug/l (February 1993) in wells IT-2 and IT-3, respectively; 1,1-DCE at a concentration of 11 ug/l (February 1993) in well IT-3; and 1,2-DCE at 78 ug/l in well IT-2 (March 1992). The presence of VOCs in these wells indicates that contaminants have migrated from source areas on-site to downgradient, off-site locations.

Ground water samples collected during February and March 1993 from the southern residential areas further downgradient from the site also revealed the presence of VOCs. Downgradient ground water samples containing VOCs at concentrations exceeding ARARs were observed at locations PGP-06, PGP-07, PGP-08, and PGP-09. VOC concentrations in most of these off-site samples, collected using a hydraulic Geoprobe, were significantly lower than concentrations detected on-site. One exception, however, was the concentration of VOCs observed in PGP-09, from a depth of 13 to 15 feet, where TCE was detected at 1600 ug/l and TCA was detected at 340 ug/l.

Unit D deep wells IT-1A, MW-23 and MW-25 all had PCE values exceeding ARARs, and MW-23 had a TCE value exceeding ARARs in 1992. After extensive purging in 1992 and 1993, none of the deep wells had PCE values exceeding ARARs in 1993 and only MW-25 had a TCE value exceeding ARARs in 1993. Because of this response to purging, it is judged that the deep well contamination observed in 1992 was probably due to carry down of small amounts of contaminants, and not due to general contamination of Unit D.

There are currently no uses of ground water at or adjacent to the site. Ground water could only be a potential route of exposure if wells were installed at or near the site in the future. Furthermore, under current conditions, any wells installed in the area of highest contamination would likely be used for industrial purposes and not for drinking water.

5.6.2 Previously Collected Data

Appendix A summarizes data from previous sampling at the site. These historical data are presented as a comparison to the current site conditions as described above.

5.6.2.1 Soils

Previous investigations, especially those conducted in 1984 showed the presence of several contaminants in soils at the site. The major VOC detections in each of the five investigations summarized in this table were PCE, TCE, and TCA. These three contaminants coincide with those contaminants detected at greatest concentration in the recent sampling discussed above. The September 1984 hand auger soil investigation (in the area of the former plating room at the site) generally revealed the highest levels of soil contamination. As discussed in earlier sections of this report, a significant quantity of soil was removed from this area of the site as part of previous remedial activities.

5.6.2.2 Surface Water

Previous sampling has indicated the presence of site related VOCs in surface water. Sampling of downstream locations of Hurricane Creek in 1986 by IT showed the presence of four VOCs (PCE, TCE, 1,1,1-TCA, and 1,1,2-TCA) at low ug/l concentrations. Higher concentrations (but less than 1,000 ug/l) of these VOCs were also observed in samples taken directly from the storm. While these results indicate potentially greater impacts at that time, none of the concentrations exceeded either the acute or chronic LOELs for these VOCs.

5.6.2.3 Ground Water

Prior to the 1992 and 1993 sampling events, ground water monitoring wells at the site were last sampled as part of the 1986 quarterly monitoring program by IT. The 1986 quarterly data and results of other previous investigations indicate that three VOCs have generally been observed at highest concentrations in on-site wells. These are TCA, TCE, and PCE. The maximum

concentrations of these compounds in the 1986 sampling rounds were 24,000 ug/l PCE, 24,000 ug/l TCA and 14,000 ug/l of TCE. These past concentrations are higher than concentrations observed in the more recent sampling. Figure 14b shows a reduction in present concentrations for the VOCs TCA and PCE to approximately one third their 1986 values.

Previous sampling has also shown greater VOC concentrations in off-site wells IT-2 and IT-3 than at present. The 1986 quarterly monitoring results for these wells showed the three major site contaminants present at the following maximum concentrations: PCE at 290 ug/l, TCA at 200 ug/l, and TCE at 130 ug/l. Figure 14a shows a reduction in present concentrations for the VOCs TCE and TCA to approximately one third their 1986 values. Figures 14a and 14b also indicate that contaminant levels north of the storm sewer are 250 times or more greater than those south of the storm sewer.

5.7 Uncertainty

Risk assessment provides a systematic means for organizing, analyzing and presenting the nature and magnitude of potential risks posed by chemical exposures. The qualitative risk measures used in this assessment, however, are not precise estimates of risk, but are estimates given a considerable number of assumptions about exposure and toxicity. The purpose of this uncertainty assessment is to clarify the assumptions and uncertainties inherent in the RA process and to place the risk estimates in proper perspective.

There are uncertainties associated with the toxicity values which are used to develop several of the ARARs utilized in the data comparison. Present scientific information is insufficient to provide a thorough understanding of the potential health impacts of chemicals to which humans are exposed. Human RfDs and carcinogenic Slope Factors are often based on potential toxic effects to non-human species. Uncertainty arising in extrapolating from animal data can be due to differences in chemical uptake, distribution, and metabolism, differences in enzyme subspecies, and differences in relative surface area to body weight ratios. To account for uncertainties in extrapolating from one species to another, uncertainty factors (generally multiples of ten) are often employed. When human data are used to calculate reference doses, safety factors are still applied to reflect the relative quantity or quality of the data or to protect from intra-species variations, such as allergenic or hypersensitive responses. Uncertainty may also result from low confidence in laboratory experimental or epidemiological methodologies.

There is uncertainty in the estimated exposure assumptions inherent in the ARARs identified. For instance, in developing residential PRGs, it is assumed that people will live on or near the site for 30 years; this assumption probably overestimates the duration of residence because it is a national upper bound statistic. An exposure frequency of 350 days/year for current and future residential populations is also probably an overestimate for soil ingestion and dermal contact since climatic factors (such as temperature and snow cover) might preclude soil exposures for extended periods. Furthermore, non-residential exposures based on current and future industrial uses of the site may be overestimated as well.

There are several areas of uncertainty regarding the potential future land uses at the site. For instance, based on current land use and zoning, the property is expected to support industrial/commercial use in the future. Thus the assumption of residential exposure for areas of soil contamination may be overly conservative. In addition, the assumption that residential and industrial occupants could use on-site ground water as a drinking water supply may also be unrealistic because the area is currently served by a municipal water system.

5.8 Site Evaluation

This qualitative RA indicates that potentially hazardous chemicals are present in environmental media at the former Amphenol site, both on-site and off-site to the south. The results of the ground water portion of this RFI indicate that contaminant levels on-site and off-site are at steady state or decreasing. Potentially significant exposures to those contaminants in ground water and soil are limited due to their subsurface location and the lack of use of ground water for drinking on and near the site. Based on risk calculations in Section 5.6.1.2, exposures to contaminated surface water by children playing at the storm sewer outlet into Hurricane Creek were determined to not result in unacceptable risk.

Based upon the results of this RFI, the former Amphenol site does not pose an unacceptable risk to human health and the environment under current conditions but may pose a risk some time in the future. It is recommended that periodic monitoring of on-site and off-site conditions be undertaken as a follow-up to this RFI.

6.0 ECOLOGICAL RISK ASSESSMENT

6.1 Introduction

The purpose of this section is to provide a qualitative determination of the actual or potential effects of releases from the former Amphenol site on plants and animals other than people or domesticated species. As established in preceding sections of this RFI report, compounds of potential concern in the ground water on the site are intercepted by the storm sewer and subsequently carried to Hurricane Creek. Effects of these releases from the site on ecosystems and the biota in and near Hurricane Creek are discussed in this section.

Guidance for this section of the RFI report is provided by:

- 1) "Risk Assessment Guidance for Superfund, Volume II: Environmental Evaluation Manual" (RAGS Volume II, EPA/540/1-89/001)
- 2) "Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference" (EPA/600/3-89/013)
- 3) U.S. EPA Region 5 August, 1992 Revision of Regional Guidance for Conducting Ecological Assessments
- 4) "ECO Updates" from the U.S. EPA Office of Emergency and Remedial Response, Hazardous Site Evaluation Division

6.2 Site Characterization

6.2.1 Aquatic and Terrestrial Habitats

The area selected for this assessment is located in and along Hurricane Creek and the outfall drainageway into the creek. It begins just upstream from the outfall drainageway confluence and ends at the Forsythe Street bridge over Hurricane Creek, about 1,000 feet downstream from the

outfall confluence (Sheet 3). The outfall drainageway is an excavated channel beginning at the end of the 72-inch storm drain, and ending approximately 200 feet south of the drain where it enters Hurricane Creek on its north bank.

6.2.1.1 Aquatic Habitat

The headwaters of Hurricane Creek are in northern Johnson County, about 10 miles north of the site. In the vicinity of the site, the drainage area of the creek is approximately 15.6 square miles, and most of the land use in the drainage area is agricultural. Hurricane Creek enters Youngs Creek about one half mile downstream from the assessment area. There are no published flow records for Hurricane Creek. Data presented in the IT Work Plan indicate that the 1-7 Day Mean Low Flows for Hurricane Creek are 0.0 cfs. Flow measurements taken in Hurricane Creek in the vicinity of the outfall drainageway for previous REI work varied between 3.19 and 3.76 cfs, and a flow measurement of 0.06 cfs was recorded at the storm drain outfall on February 25, 1992 (Table 4). At that time water flow in the creek was about fifty times that in the storm drain outfall.

Hurricane Creek in this reach flows in a series of pools and riffles in a channel 8 to 12 feet wide with a water depth of 3 to 18 inches. Stream flow is from northeast to southwest. The bottom sediments consist of a 6- to 18-inch layer of unsorted sand, gravel and cobbles. Beneath the sediments is a layer of dense gray clay that could not be penetrated by a hand probe. The creek channel in this reach does not meander and may have been dredged and straightened in the past, although there is little evidence for the deposition of spoil piles on either creek bank. A 12-inch corrugated metal drainage pipe enters the creek on the north side about 150 feet downstream from the outfall channel, probably street drainage from Ross Court. There are no significant tributaries to the creek in this reach with the exception of the storm drain outfall channel. The U.S. Fish & Wildlife Service National Wetland Inventory (NWI) map indicates that Hurricane

Creek in this reach is an excavated lower perennial riverine wetland with an unconsolidated bottom (R2UBHx). The pools will provide habitat for fishes and crayfish while the riffles provide cover and habitat for aquatic macroinvertebrates.

The storm drain outfall channel is about 200 feet long, 3 to 5 feet wide and generally 3 to 6 inches deep. The channel begins at the 72-inch storm drain outfall pipe, flows to the south and appears to have been artificially constructed. The storm drain outfall is filled to a depth of about 2 feet with cobbles and large gravel, apparently dumped there in the past, perhaps from the adjoining farm field. This cobble area extends about 30 feet downstream and could not be penetrated with a probe to determine thickness. The cobbles are replaced in the channel by a soft mud/sand bottom which varies between 30 and 54 inches in thickness. The mud/sand bottom is underlain by Unit C, the same dense gray clay layer as exists beneath Hurricane Creek. The flow velocity in the outfall channel is insufficient to clear the channel of fine sediments; however, as a result of the higher flow velocity in Hurricane Creek, these sediments are not present in the creek channel. Strands and mats of blue-green algae are present in the outfall channel. Because of the shallow depth and sandy bottom along most of the channel it offers little in the way of habitat for fishes, crayfish or aquatic macroinvertebrates.

There are no published or agency file reports cataloging fauna from Hurricane Creek. A copy of a report of a 7/23/91 fish survey on Youngs Creek just downstream from Franklin was obtained from the Indiana Division of Fish & Wildlife. An opinion about the types of mussels that might be present in the creek was provided by Robert Anderson of the Indiana Division of Fish & Wildlife. Macroinvertebrate information was provided by the author's knowledge of aquatic macroinvertebrates in small streams in central and southern Indiana.

Because the stream does not always flow, an extensive mussel fauna is not anticipated, and individuals may be rare. To date no mussels have been observed in or near the assessment area

based upon visual investigations. Mussels such as the giant floater (*Pyganodon grandis*), lilliput (*Toxolasma parvus*), threeridge (*Amblema plicata*), papershells (*Anodonta* sp., *Anodontoides* sp.) and the fat mucket (*Lampsilis siliquioda*) may be discovered occasionally in areas of deeper water and/or thicker sediments. Freshwater clams (*Corbicula* sp.) and fingernail clams (*Sphaeria* sp.) also may be present occasionally.

Fishes may include small individuals such as the creek chub, bluegill and sunfishes, bullheads, common and striped shiner, common stoneroller, silverjaw minnow, bluntnose minnow and several sucker species. The species listed above include predators (feeders on macroinvertebrates, microinvertebrates, smaller fishes), herbivores (feeders on algae), and feeders on bottom detritus. Crayfish are also likely to be present. When fish and crayfish have been observed in Hurricane Creek, few have been observed in the storm drain outfall channel.

Aquatic insects and macroinvertebrates are expected to include water striders, chironomid and simuliid larvae (Diptera), various dragonfly and damselfly larvae (Odonata), amphipods (*Hyaella* sp.) and aquatic beetle larvae.

The Indiana Water Resource (IDNR, 1980) shows Hurricane Creek as having a low quality fisheries habitat.

6.2.1.2 Terrestrial Habitat

See Figure 15. The creek runs mostly within cut banks. The surface of the water is about 2 feet below the surrounding land surface on the north side, and about 5 to 6 feet below the surrounding land surface on the south side. West of Forsythe Street, the riparian habitat is in grass on both sides of the creek. East of Forsythe Street, the riparian habitat is in grass on both sides of the creek up to the eastern edge of the PSI substation property. East of this boundary the

south side of the creek is wooded. This wooded area continues upstream past the confluence with the storm drain channel. On the north side of the creek is a thin belt of trees behind which is grassed land up to the storm drain channel. The storm drain channel and the north side of the stream upstream of the channel is wooded. The common tree species are boxelder, sycamore, bitternut hickory, elms, silver maple, ash and black willow. The noted understory vegetation is rather sparse, and at the time of year it was viewed, appeared to consist of poison ivy and honeysuckle. There are no seeps, springs, abandoned channels, areas of standing water or other potential wetlands adjacent to the creek. Deer and raccoon tracks were noted along the stream bank. Squirrels, opossums, small rodents and snakes are expected to be present in the wooded portions of the riparian corridor. There is little suitable habitat for amphibians.

Land use away from the riparian corridor is a mixture of commercial, residential and agricultural. It is expected that much of the surrounding area, as well as the Hurricane Creek watershed, will become increasingly urbanized in the future.

The Indiana Water Resource (IDNR, 1980) shows Hurricane Creek as having a low quality riparian habitat.

6.2.2 Sensitive Species/Habitats

Outside of Hurricane Creek itself, there are no wetlands in the assessment area. There are no sensitive habitats which might be affected by releases from the former Amphenol facility. There are no known endangered species at this site. A letter from the U.S. Fish & Wildlife Service, Bloomington, Indiana Field Office, states that no Federally endangered species (including the Indiana bat) will be affected (Appendix M). The creek is too small and the area too urbanized and developed to be a significant resource for waterfowl.

6.2.3 Nature of Contamination

Water samples collected on February, 1985 at the storm drain outfall, at the outfall confluence with Hurricane Creek, and in Hurricane Creek 2,000 feet upstream and 2,200 feet downstream from the outfall are shown below:

VOC Compound (ug/l)	Upstream	Outfall	Confluence	Downstream
carbon disulfide	<10	37	3.8	15
1,1-DCA	<1	3	<1	<1
1,2-DCA	<1	<1	<1	<1
1,1-DCE	<1	<1	<1	<1
PCE	<1	240	12	2.2
1,1,1-TCA	<1	270	11	1.4
1,1,2-TCA	<1	36	36	<1
TCE	<1	780	34	7.5

The compounds PCE, 1,1,1-TCA and TCE had the greatest concentrations at the outfall. The concentration of each decreased by a factor of 20 to 25 at the confluence with Hurricane Creek, and decreased at the downstream sampling point by a factor of 100 for PCE and TCE, and a factor of 200 for 1,1,1-TCA. A similar set of measurements collected for this RFI on February 26, 1992 indicated no VOCs at any of the sampling points. At that time, the ground water piezometric surface was below the storm sewer invert at the facility.

Other VOC analytical data for storm sewer outfall samples from February, 1986 through February, 1993 (Table 5 and Table A-2 in Appendix A) are summarized below:

VOC Compound (ug/l)	2/86	5/86	8/86	11/86	2/92	7/92	2/93
carbon disulfide	<1	<1	<1	<1	<5/<5	<5	<5
1,1-DCA	<1	4.4	<1	4.1	<5/<5	<5	3J/3J
1,2-DCA	3.1	15	<1	<1	<5/<5	<5	<5/<5
1,1-DCE	<1	1.0	35	1.1	<5/<5	<5	<5/<5
PCE	58	1500	96	23	<5/<5	35	84/85
1,1,1-TCA	31	720	69	89	<5/<5	9	33/35
1,1,2-TCA	<1	<1	<1	<1	<5/<5	<5	<5/<5
TCE	120	850	200	190	<5/<5	17	65/55

The measurements taken in May, 1986 show peak values for most compounds that have not been duplicated since. The compounds with the highest concentrations are again PCE, 1,1,1-TCA and TCE. By 1992, these are the only compounds that could be measured above detection limits in the outfall water. A sediment sample and duplicate collected at the outfall (SD-2 collected 2/6/92) was found to contain the following VOC compounds:

acetone (ug/kg)	33B/26B
methylene chloride (ug/kg)	42/28
PCE(ug/kg)	<5/4J

PCE was measured below the detection limit. Neither cyanide compounds nor significant levels of metals have been detected in either the surface water or the sediment.

6.2.4 Documented Effects to Hurricane Creek

A fish kill in Hurricane Creek between Forsythe Street and King Street was reported in the local newspaper on September 8, 1980. It was suspected that Morgan Packing Company (no longer present) dumped cooling waste water into the creek. The Johnson County Health Department did not believe that there was a human health hazard involved. There is no follow up documentation.

Two Indiana Conservation Officers entered the storm sewer on April 29, 1984 while investigating the release of 400 to 500 gallons of liquid fertilizer into the storm sewer from a farm chemical dealer located at 760 East Hamilton Avenue. There is an opening into the sewer near this location. The officers reportedly were overcome by fertilizer fumes in the sewer, while improperly using SCBA equipment. A light fish kill was reported in Hurricane Creek downstream to its confluence with Youngs Creek. Within a day, fish were again reported in the creek near Forsythe Street. A fish kill count was reportedly conducted by the Indiana Department of Natural Resources, but no record of the count could be located. There is no follow up documentation.

No records of fish kill studies or reports on Hurricane Creek were found at the Indiana Department of Natural Resources.

On July 27, 1992 WWES personnel gauging and sampling at the outfall noted the outfall water become suddenly turbid, and there was a definite smell of ammonia. Several small minnows in the outfall channel died and were swept away. After several minutes the turbidity and ammonia smell dissipated. The Johnson County Health Department was immediately contacted. That agency suspected that a release had occurred at the farm chemical dealer noted above.

None of the incidents reported above pertain to releases from the former Amphenol facility.

6.3 Preliminary Screening

6.3.1 Contaminant Pathways

Based upon the previous sampling data, compounds of potential concern in ground water are carried to potential aboveground target systems in water flowing into Hurricane Creek via the storm drain.

6.3.2 Identification and Characterization of Contaminants

Based on sampling information from Hurricane Creek the following compounds are of potential concern to the aquatic environment. Their physical characteristics are listed below.

Compound	Specific Gravity	Vapor Pressure (20/25°C)	Solubility	Log P _{oct}	BCF*
carbon disulfide	1.263	297 mm Hg	2,100 mg/l (20°C)	1.7-4.16	7.9 ns
1,1-DCA	1.174	227 mm Hg	5,060 mg/l (25°C)	1.79	1.2 ns
1,2-DCA	1.25	78.7 mm Hg	8,524 mg/l (25°C)	1.48	0.3 ns
1,1-DCE	1.218	500 mm Hg	400 mg/l (20°C)	1.48	ND
PCE	1.626	18.49 mm Hg	1,503 mg/l (25°C)	3.40	49 ns
1,1,1-TCA	1.35	123.7 mm Hg	347 mg/l (25°C)	2.49	8.9 ns
1,1,2-TCA	1.44	30.3 mm Hg	4,420 mg/l (20°C)	2.07	<1 ns
TCE	1.46	69 mm Hg	1,100 mg/l (25°C)	2.42	39 ns

* - BCF values as reported in Howard (1990); ns - nonsignificant bioconcentration

All of the compounds are denser than water, and are soluble in water to varying degrees. They all readily volatilize and will be lost from the water by that mechanism. The log Octanol/Water Partition Coefficients (Log P_{oct}) are all low, suggesting low potentials for bioconcentration and for adsorption onto soil particles. Bioconcentration factors (BCF) are reported as nonsignificant for all compounds, and none of the compounds of potential concern is expected to be carried upward through the food chain.

6.3.3 Target Environments/Organisms

Based upon the initial site characterization, and potential contaminant characterization, the aquatic environment of Hurricane Creek will not receive any impact from the compounds of potential concern. The terrestrial/riparian environment will seldom be affected by contact with creek water, and then only during periods of significant flooding when dilution of outfall water will be the greatest. Stream sediments contained negligible concentrations of VOCs when sampled, and given their physical characteristics, the compounds are not expected to adsorb onto soil particles.

Potentially affected organisms will consist of small fishes, crayfish and aquatic macroinvertebrates. Youngs Creek is a colonization source for the fish and crayfish.

Macroinvertebrates are mainly the larvae of flying insects, most of which are replenished yearly. There is not expected to be a significant mussel fauna in Hurricane Creek.

6.3.4 Toxicological Properties of Contaminants and Exposure Assessment

The compounds of potential concern are summarized below along with appropriate conservative published fresh water exposure information. Fresh water exposure standards from the "Quality Criteria for Water" (USEPA, 1992) are not developed for these compounds. The Lowest Observed Effect Level (LOEL) is used when available, or information from "Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Final Report" (report to USEPA, GCA Corp., 1985), or from Verschueren (1983). The maximum concentrations of VOCs in the outfall water, expressed in mg/l to facilitate comparison, are also included.

Compound	LOEL	GCA	Verschueren	Max. Conc.
carbon disulfide				0.037 mg/l
acute	ND	ND	TLm (96 hr) - 135 mg/l	
chronic	ND	ND	-	
1,1-DCA				0.044 mg/l
acute	118 mg/l	118 mg/l	LC ₅₀ (96 hr) - 550 ppm	
chronic	20 mg/l	20 mg/l	-	
1,2-DCA				0.015 mg/l
acute	118 mg/l	118 mg/l	LC ₅₀ - 500 ppm	
chronic	20 mg/l	20 mg/l	-	
1,1-DCE				0.035 mg/l
acute	11.6 mg/l	11.6 mg/l	LC ₅₀ (96 hr) - 220 ppm	
chronic	ND	ND	-	
PCE				1.5 mg/l
acute	5.28 mg/l	5.28 mg/l	LC ₁₀ (24 hr) - 15.1 mg/l	
chronic	0.84 mg/l	0.84 mg/l	-	
1,1,1-TCA				0.72 mg/l
acute	ND	18 mg/l	EC ₁₀ (24 hr) - 10.5 mg/l	
chronic	ND	8.4 mg/l	-	
1,1,2-TCA				0.036 mg/l
acute	ND	18 mg/l	LC ₅₀ (7 day) - 94 ppm	
chronic	9.4 mg/l	9.4 mg/l	-	
TCE				0.85 mg/l
acute	45 mg/l	45 mg/l	EC ₁₀ (24 hr) - 10.5 mg/l	
chronic	21.9 mg/l	ND	-	

Information from Verschueren is based on the most conservative test results involving freshwater fishes. LC_{xx} is the calculated concentration of a material which when administered by the respiratory route (gills) is expected to kill xx percent of the test animals during the indicated time period. EC_{xx} is the calculated concentration expected to produce an observable adverse effect on xx percent of the test animals during the indicated time period. Loss of equilibrium was the effect measured. TLM is the median tolerance limit, the limit at which 50 percent of the organisms will survive exposure for the specified time period.

The summary above indicates that the chronic LOEL value (0.84 mg/l) for PCE was exceeded in May, 1986 when a concentration of 1.5 mg/l was measured at the Hurricane Creek outfall. No other measured values for PCE or for the other compounds of potential concern exceeded exposure values at any time.

6.3.5 Risk Characterization

6.3.5.1 Uncertainty

The criteria used in this ecological risk assessment are not precise estimates of the risk, but are estimates entailing a number of assumptions about toxicity and exposure. The purpose of this section is to clarify the assumptions and uncertainties, and to place the risk estimates in proper perspective.

There are uncertainties associated with the toxicity information presented in the preceding section. Fresh water exposure criteria have not been developed for the compounds of concern, and LOEL values or the published results of toxicity tests were used for comparison. The latter varied in the selection of test animals, the presentation of the data, and the effects measured, making precise comparison with the analytical data difficult. LOEL values may be developed

utilizing a number of assumptions, testing methods, statistical methods, observed effects, test animals and exposure times which may not be indicative of actual conditions on Hurricane Creek. Uncertainty may also result from low confidence in laboratory experimental methods. The utilization of exposure values developed from tests on freshwater fishes may not be applicable to crayfish and macroinvertebrates. No additive effects from exposure to multiple compounds are assumed or accounted for in the exposure values.

There is uncertainty in the exposure of organisms. The actual exposure encountered by aquatic organisms in Hurricane Creek will seldom if ever be as high as at the storm drain outfall. Reductions in VOC concentrations resulting from volatilization and dilution are expected from the physical data presented for the compounds. A fifty-fold reduction of compounds in outfall water as a result of dilution by Hurricane Creek would be expected based upon the differences in flow indicated in Table 4. Twenty- to twenty five-fold reductions were measured in February, 1985 (Section 6.2.3). The duration of exposure also is uncertain because of the time intervals between samples. Conditions which led to the peak compound values measured in May, 1986 are not known, but they apparently have not been duplicated during any sampling event since that time.

There also are uncertainties about the effects of increased development and urbanization in Franklin and the Hurricane Creek watershed on both the aquatic and riparian habitats of the creek. Habitat types and composition of the flora and fauna may shift in the future as a result of changing land use, resulting in different target populations. Additional uncertainties arise when taking into account future remediation and abatement activities at the former Amphenol site. Remediation activities which lower the piezometric surface below the invert elevation of the storm drain on site would effectively eliminate the storm drain as a pathway for the compounds of concern.

6.3.5.2 Site Evaluation

This Ecological Risk Assessment indicates that VOC compounds of potential concern are being introduced into Hurricane Creek from the former Amphenol site via the storm drain outfall. VOCs have been measured in the outfall water from 1985 through 1992. During that period, the compounds carbon disulfide, 1,1-DCA, 1,2-DCA, 1,1-DCE, 1,1,1-TCA, 1,1,2-TCA, PCE and TCE have been measured above detection limits. Neither cyanides nor significant levels of metals have been detected in the outfall water. The target populations consist of aquatic organisms, primarily small fishes, crayfish and aquatic macroinvertebrates. No fish kills or environmental incidents attributable to the former Amphenol site have been documented in or along Hurricane Creek. None of the compounds in question is expected to bioaccumulate to a significant degree. Comparison of maximum values of VOCs in the outfall water with LOEL values and published results of exposure of freshwater fishes to the compounds indicates a single instance in May, 1986 when the chronic LOEL for PCE was exceeded.

Based upon the results of this Ecological Risk Assessment, the effects on fishes, crayfish and aquatic macroinvertebrates from VOCs introduced into Hurricane Creek from the former Amphenol site via the storm drain outfall are minimal now and have been minimal in the past. Site remediation activities will eliminate any potential future effects on the aquatic fauna of Hurricane Creek.

7.0 ADDITIONAL SAMPLING AND ANALYSIS

7.1 Introduction

A draft final report on results and conclusions of the former Amphenol RFI was submitted to Region V U.S. EPA April 27, 1993. At the time of submittal of the draft final report, off-site sampling and analysis remained unfinished owing to adverse field conditions encountered in March and April, 1993. Sampling efforts on private property south of the former Amphenol site had to be postponed due to excessively wet field conditions limiting access to desired sampling locations. In addition, sampling efforts conducted in the public right-of-way at PGP-11 along Forsythe Street in March, 1993 were unsuccessful due to a lack of sufficient ground water for sampling. This section describes the following additional sampling and analytical activities.

- April and May, 1993: four ground water screening samples and three ground water analytical samples collected along Forsythe Street
- April, 1994: one soil profile, one soil analytical sample and three ground water analytical samples collected along Forsythe Street.
- December, 1994: two soil analytical samples collected along Forsythe Street.

7.2 Sampling Activities

7.2.1 Ground Water Screening

Ground water screening samples were collected on May 21, 1993 with the Geoprobe at four locations along Forsythe Street using sampling methods described in section 3.6.4.2. Screening samples SGP-31 and SGP-32 were collected at a private residence located at 835 Forsythe. Sample SGP-31 was collected 73.7 feet east of Forsythe Street, and sample SGP-32 was collected at 132 feet east of Forsythe Street. Samples SGP-29 and SGP-30 were collected west of Forsythe Street along the north property line of a Franklin Power Products facility at 400 Forsythe Street. Sample SGP-29 was collected 50 feet west of Forsythe Street, and sample SGP-30 was collected 150 feet west of Forsythe Street.

7.2.2 Analytical Samples

Three ground water analytical samples were collected with the Geoprobe on May 21, 1993. Sample locations were shown on Sheet 3. Sampling at PGP-12 and PGP-13 was postponed from earlier sampling events due to wet field conditions. Sample PGP-14 was collected 100 feet north

of sample point PGP-11 because of an unsuccessful ground water sampling attempt at PGP-11 (section 4.1.1). One soil analytical sample and three additional ground water analytical samples were collected with the Geoprobe on April 29, 1994. These samples were collected to characterize subsurface conditions between previous sampling points. The sampling locations are shown on Figure 3 as PGP-15, PGP-16, and PGP-18. A soil analytical sample was collected at PGP-15 at a depth of 9 to 11 feet. Soil at PGP-17 was sampled to determine subsurface stratigraphy. Soil analytical samples were collected from 9 to 11 feet at PGP-16 and PGP-18 on December 2, 1994. Sampling methods are described in section 3.6.4.2. Soil samples were analyzed for VOCs. Ground water samples PGP-12, -13, -14, -15, -16, and -18 were analyzed for VOCs, metals and cyanide. In addition to the analytical samples, duplicate, matrix spike/duplicate, equipment blank and trip blank samples were collected for QA/QC analyses.

7.3 Results

Results of ground water VOC screening analyses performed on samples SGP-29 through SGP-32 are included in Table 10. No VOCs were detected at SGP-32, 132 feet west of the street at 835 Forsythe. PCE was not detected in any of the four samples. TCA and TCE were detected in samples SGP-29, -30 and -31. DCA was detected only in sample SGP-31 (Appendix H).

Analytical results for ground water samples PGP-12, -13, and -14 are included in Table 8. Laboratory analytical reports are included in Appendix J, and data validation worksheets are included in Appendix K. No VOCs were detected in samples PGP-12 or PGP-14. TCE and TCA were detected in samples PGP-13 and PGP-13D at concentrations exceeding ARARs or site background levels as established in section 4.8. Six metals were detected at concentrations exceeding ARARs (section 4.3), as indicated by shaded values in Table 8. However, arsenic, detected in PGP-14, was reported as less than the MCL, and aluminum, cobalt, iron, lead and manganese were detected at levels similar to those found in ground water at the site. Consequently, these detections are interpreted as normal background levels, unrelated to activities at the former Amphenol site.

Previous sampling efforts at PGP-11 (Sheet 3) failed to yield sufficient ground water volume for analytical samples, and suggested that Unit B (Sheet 4A) is very thin at this point. The April 1994 sampling efforts at PGP-17 confirmed that the thickness of the saturated zone at PGP-17 is insufficient to permit collection of a ground water analytical sample using techniques approved for this RFI. Visual examination of soil material retrieved for soil classification confirmed the presence of the dry, firm loam identified as Unit C at approximately 6.6 feet below the surface.

Analytical results for soil samples PGP-15, PGP-16 and PGP-18 are included in Table 3. Laboratory analytical reports are included in Appendix J, and data validation worksheets are included in Appendix K. Seven VOCs were detected in soil sample PGP-15 (Table 8). Acetone and methylene chloride are considered laboratory artifacts, as these compounds were also detected in the equipment blank and/or trip blank samples. Ethylbenzene, toluene and xylene have not been detected in any previous RFI analyses, and are considered unrelated to the former Amphenol facility. Furthermore, reported concentrations of these three compounds are below the ARARs presented in Table 11. PCE and TCE, both frequently detected in this RFI, are present in soil sample PGP-15, at concentrations below the ARARs. Methylene chloride, 1,1,1-trichloroethane (TCA), and trichloroethene (TCE) were detected in PGP-16 and PGP-18 and in the field duplicate sample. Tetrachloroethene (PCE) was detected in both the investigative and the duplicate sample at PGP-16. Toluene was detected in the duplicate sample at PGP-16, and in the investigative sample at PGP-18. All compounds were detected at concentrations below the ARARs presented in Table 11 of the RFI report. Toluene detections during this RFI have been limited to low-level detections along Forsythe Street, well south of the former Amphenol facility, and are considered to be unrelated to the facility. PCE, TCA and TCE have been detected consistently throughout this RFI.

Analytical results for ground water samples PGP-15, PGP-16 and PGP-18 are included in Table 8. Laboratory analytical reports are included in Appendix J, and data validation worksheets are included in Appendix K. Four VOCs were detected in the ground water samples (Table 8). Methylene chloride is interpreted as a laboratory artifact, as it was also detected in the equipment blank and trip blank samples. TCA was present in all investigate samples, but at concentrations below ARARs. PCE, detected in sample PGP-15, and TCE, detected in all samples, were present at concentrations exceeding ARARs (Table 11). Cyanide concentrations were below detection limits in all ground water samples. Beryllium was detected at a concentration exceeding the ARAR in ground water samples. Beryllium was detected at a concentration exceeding the ARAR in ground water sample PGP-15. Manganese was detected in excess of the ARAR in all three ground water samples. The reported values for these metals are, however, within the range of values reported for these parameters across the site, and are therefore interpreted as naturally occurring background concentrations.

7.4 Contaminant Plume Delineation

Contaminant plume delineation was initially performed based on detections of DCA, PCE, TCA and TCE in ground water (section 4.8, Figures 6A, 6B, 6C, 6D). These sheets have been updated

to reflect the detection of VOCs in concentrations exceeding site background values (section 4.8.1) at sampling points PGP-13, PGP-15, PGP-16, and PGP-18. As PGP-13 is located upgradient from Forsythe Street, exceedances at this location are interpreted as local phenomena, and are probably unrelated to the former Amphenol site. Similar phenomena were observed at PGP-7, -9 and -10 as described in section 4.8.1. VOC detections at PGP-15, -16, and -18 substantiate previous interpretations identifying the sanitary sewer along Forsythe Street as a migration route and secondary source for VOCs originating at the former Amphenol facility (Section 4.8.3). Pipe joints and cracks are likely avenues for release of VOCs from the sanitary sewer line. Concentrations of TCA and TCE increase from PGP-15 to PGP-9, with increasing distance from the facility (Sheets 6C, 6D and 6E) These data suggest that sampling point PGP-9 may be nearer a point of release along the sewer line than other (upgradient) locations. However, DCA was detected along this segment of Forsythe Street only at PGP-9, and PCE was not detected downgradient of PGP-8. The appearance of elevated concentrations of TCA and TCE at these locations, in the absence of elevated PCE and DCA concentrations, may reflect differences in the way each of these compounds reacts with soil and water media and other physical variables.

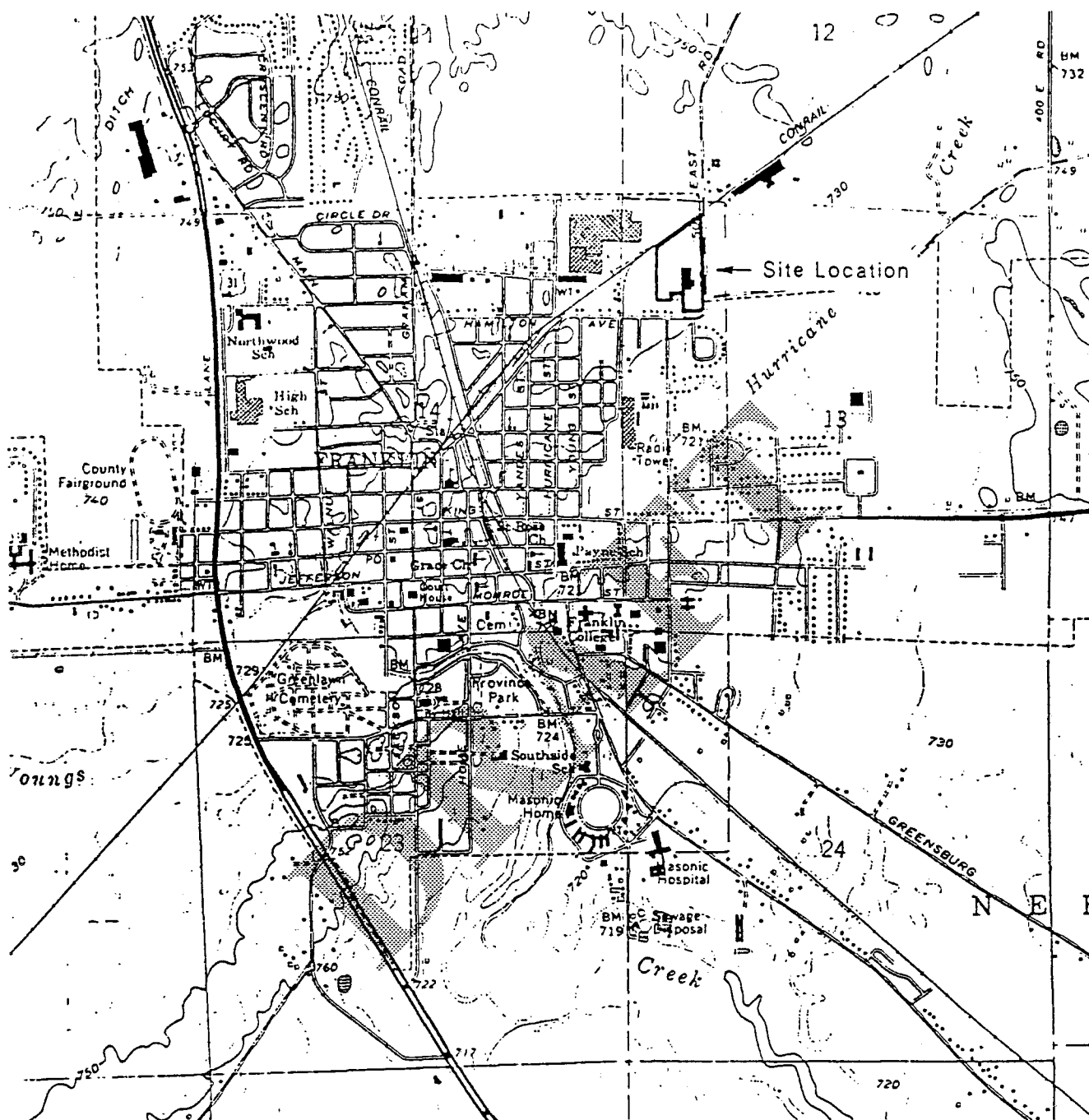
7.5 Risk Assessment

The risk assessment conclusions presented in the Section 5.6.1.1 state that potential risks associated with VOCs in ground water were minimal due to the low probability of human contact with the ground water and that there were no soil VOC concentrations exceeding ARARs in samples collected at depths less than 12 feet. The results presented herein do not alter this conclusion.

8.0 BIBLIOGRAPHY

- ATEC, 1984(a). Hydrogeologic Investigation. ATEC Associates Incorporated, Indianapolis, Indiana, May 17, 1984.
- ATEC, 1984(b). Draft Phase II Assessment Report. ATEC Associates Incorporated, Indianapolis, Indiana, August 1984.
- ATEC, 1984(c). Plating Room Investigation. ATEC Associates Incorporated, Indianapolis, Indiana, October 24, 1984.
- Buchanan, T.J., and W.P. Somers, 1976. Discharge Measurements at Gaging Stations: Techniques of Water-Resources Investigations, Book 3, Applications of Hydraulics, USGS, 65 p.
- Dragun, James, 1991. Elements in North American Soils. Hazardous Materials Control Resources Institute, Greenbelt, Maryland, 230 p.
- GCA, 1985. Chemical, physical, and biological properties of compounds present at hazardous waste sites. Final report. Prepared for U.S. EPA by GCA Corporation, Bedford, Massachusetts, September 27, 1985. 294 p.
- Gray, H.H., C.C. Ault, and S.J. Keller, 1987. Bedrock Geologic Map of Indiana, Indiana Geological Survey Miscellaneous Map No. 48.
- Howard, P.H., 1990. Handbook of Environmental Fate and Exposure Data for Organic Chemicals. Lewis Publishers, Chelsea, Michigan, 546 p.
- IDNR, 1980. The Indiana Water Resource. Indiana Department of Natural Resources, Indianapolis, Indiana, 508 p.
- IT, 1985. Site Assessment, Revised Final Report. International Technologies Corporation, Pittsburgh, Pennsylvania, August 1985.
- IT, 1988. RCRA Facility Investigation Work Plan & Quality Assurance Plan. International Technologies Corporation, Pittsburgh, Pennsylvania, October 1988.
- Littleton, R., 1993. Personal Communication.
- Malott, C.A., 1992. The Physiography of Indiana, in Handbook of Indiana Geology: Indiana Department of Conservation, pub. 21, pp. 59 - 256.

- USEPA, 1989a. Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference" (EPA/600/3-89/013)
- USEPA, 1989b. Risk Assessment Guidance for Superfund, Volume II: Environmental Evaluation Manual" (RAGS Volume II, EPA/540/1-89/001)
- Verschueren, Karel, 1983. Handbook of Environmental Data on Organic Chemicals (2nd ed.). Van Nostrand Reinhold, New York, 1310 p.
- Walton, W.C., 1962. Selected Analytical Methods for Well and Aquifer Evaluation : Illinois State Water Survey, Bulletin 49, 81p .
- _____, 1985. Practical Aspects of Ground Water Modeling: National Water Well Association, 587 p.
- WWES, 1990. Quality Assurance Project Plan for RCRA Facility Investigation/Corrective Measures Study (RFI/CMS) at the Former Amphenol Facility, Franklin, Indiana. WW Engineering & Science, Bloomington, Indiana, December 27, 1990 (revised May 25, 1991, July 26, 1991).
- _____, 1992. Work Plan for Installation of Additional Monitoring Wells and Sampling, RCRA Facility Investigation (RFI), Former Amphenol Facility, Franklin, Indiana. WW Engineering & Science, Bloomington, Indiana, October 24, 1992 (with supplement December 28, 1992).



Base taken from USGS Franklin, Ind. 7.5' topographic quadrangle



0 2000 feet
Scale

Figure 1

Former Franklin, IN Amphenol Facility
Site Location Map

WW Engineering & Science
5010 Stone Mill Road
Bloomington, Indiana 47408 • (812) 336-0972



A Summit Environmental Group Company

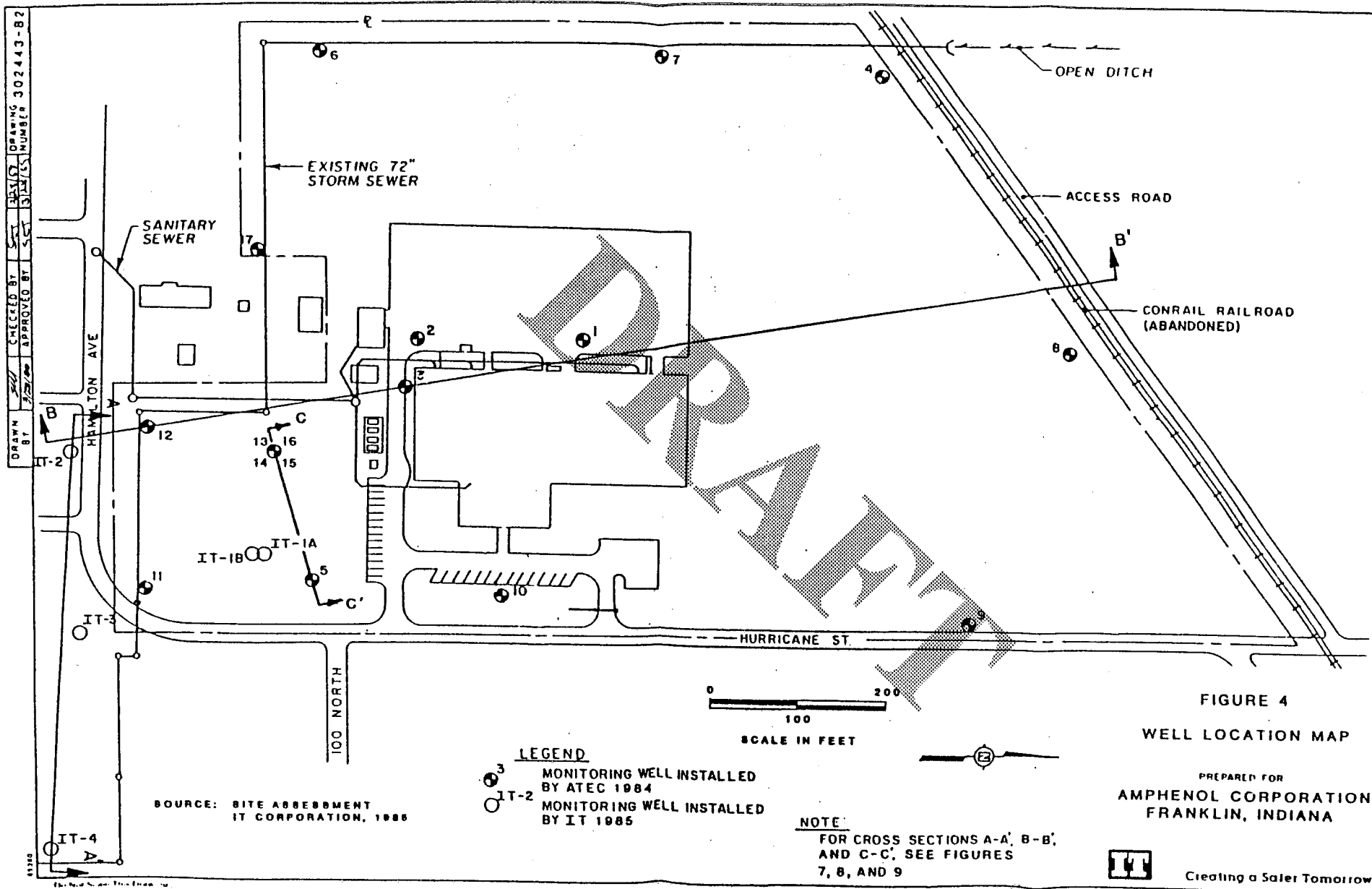
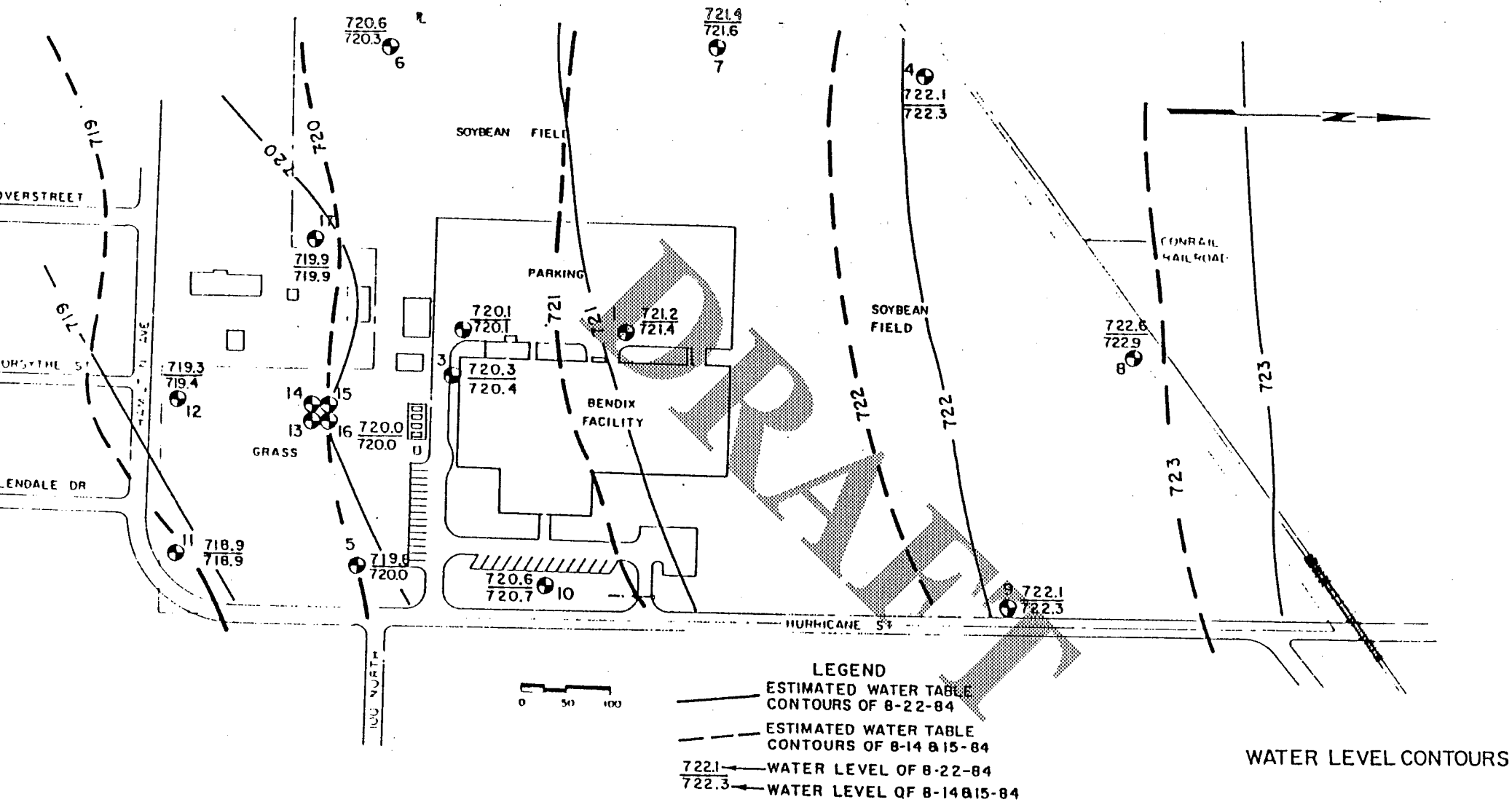


Figure 2. Site map showing locations of 1984-1985 monitoring wells (modified from IT, 1988).



ATEC ASSOCIATES

FIGURE

Figure 3. Unit B potentiometric contour map, August, 1984 (modified from ATEC, 1984b).

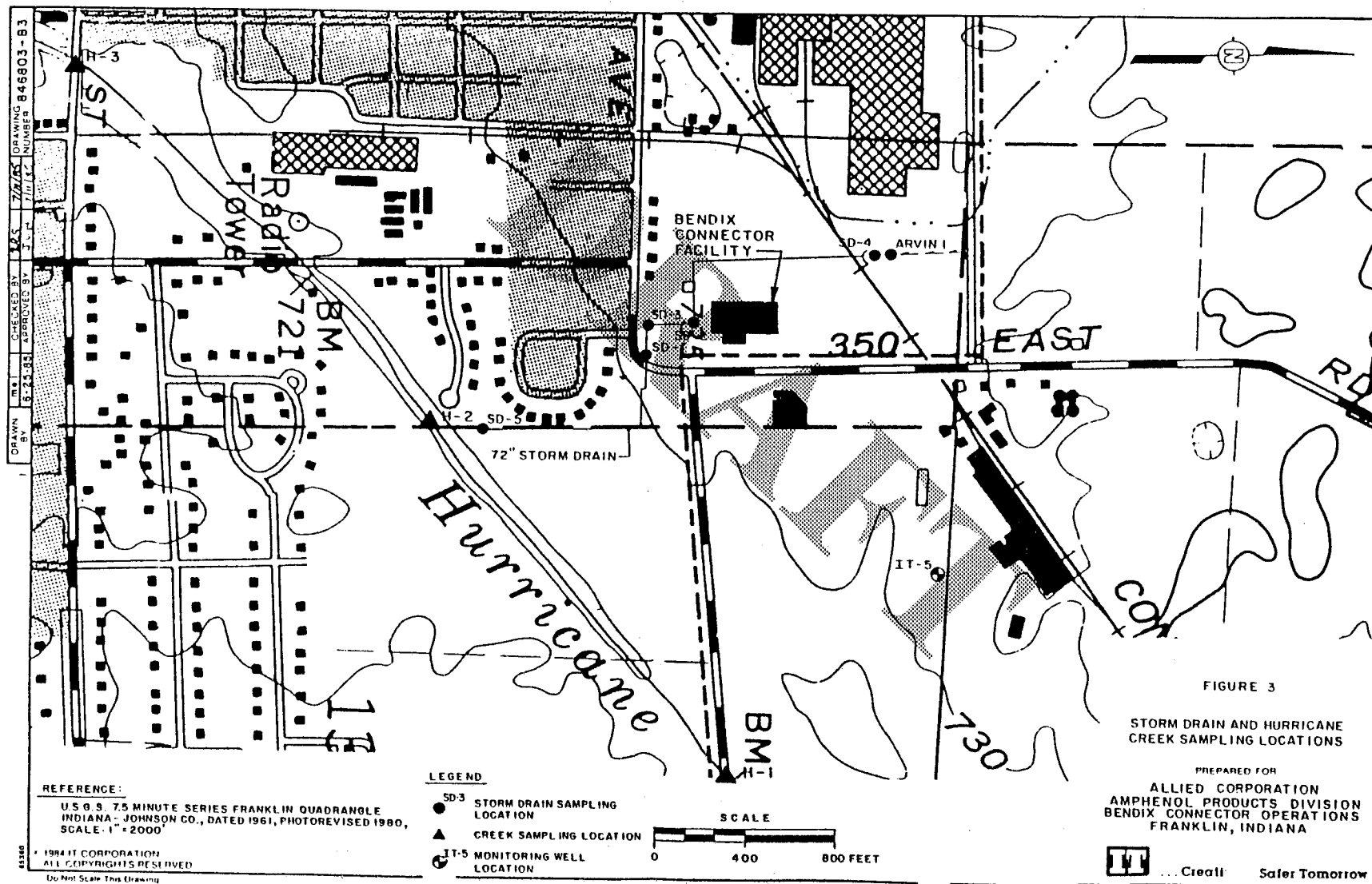
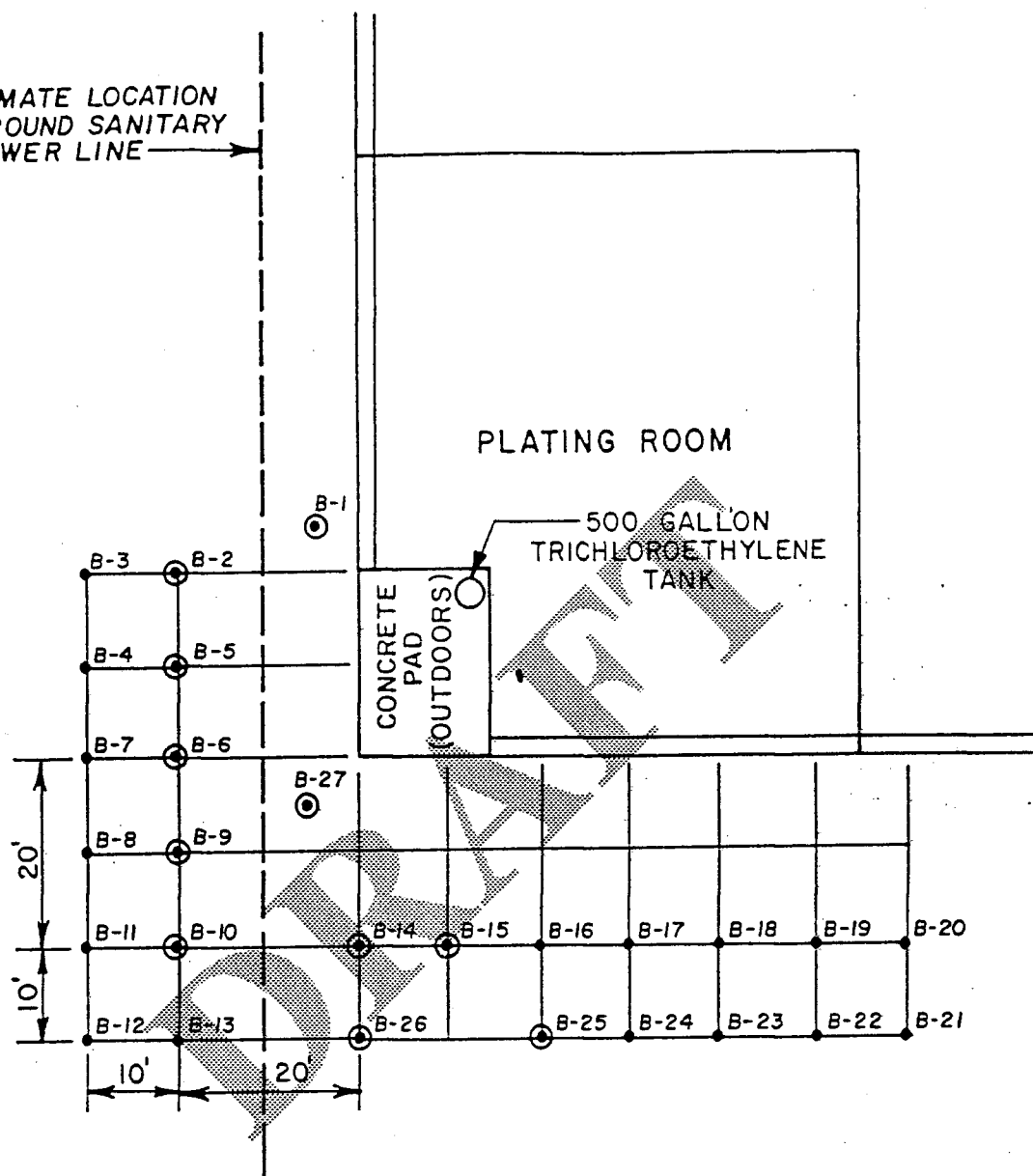


Figure 4. Map showing locations of monitoring well IT-5, and storm sewer and surface water sampling points, February - March, 1985 (modified from IT. 1985).

APPROXIMATE LOCATION
 UNDERGROUND SANITARY
 SEWER LINE



LEGEND

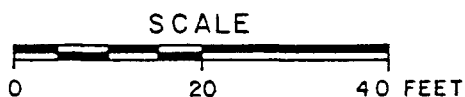
- SOIL SAMPLING LOCATION
- ⊙ SOIL SAMPLES SUBMITTED FOR VOLATILE ORGANICS ANALYSES

FIGURE 4

SHALLOW SOIL SAMPLING GRID

PREPARED FOR

ALLIED CORPORATION
 AMPHENOL PRODUCTS DIVISION
 BENDIX CONNECTOR OPERATIONS
 FRANKLIN, INDIANA



... Creating a Safer Tomorrow

Figure 5. Map showing locations of soil borings installed during 1985 plating room investigation (modified from IT, 1985).

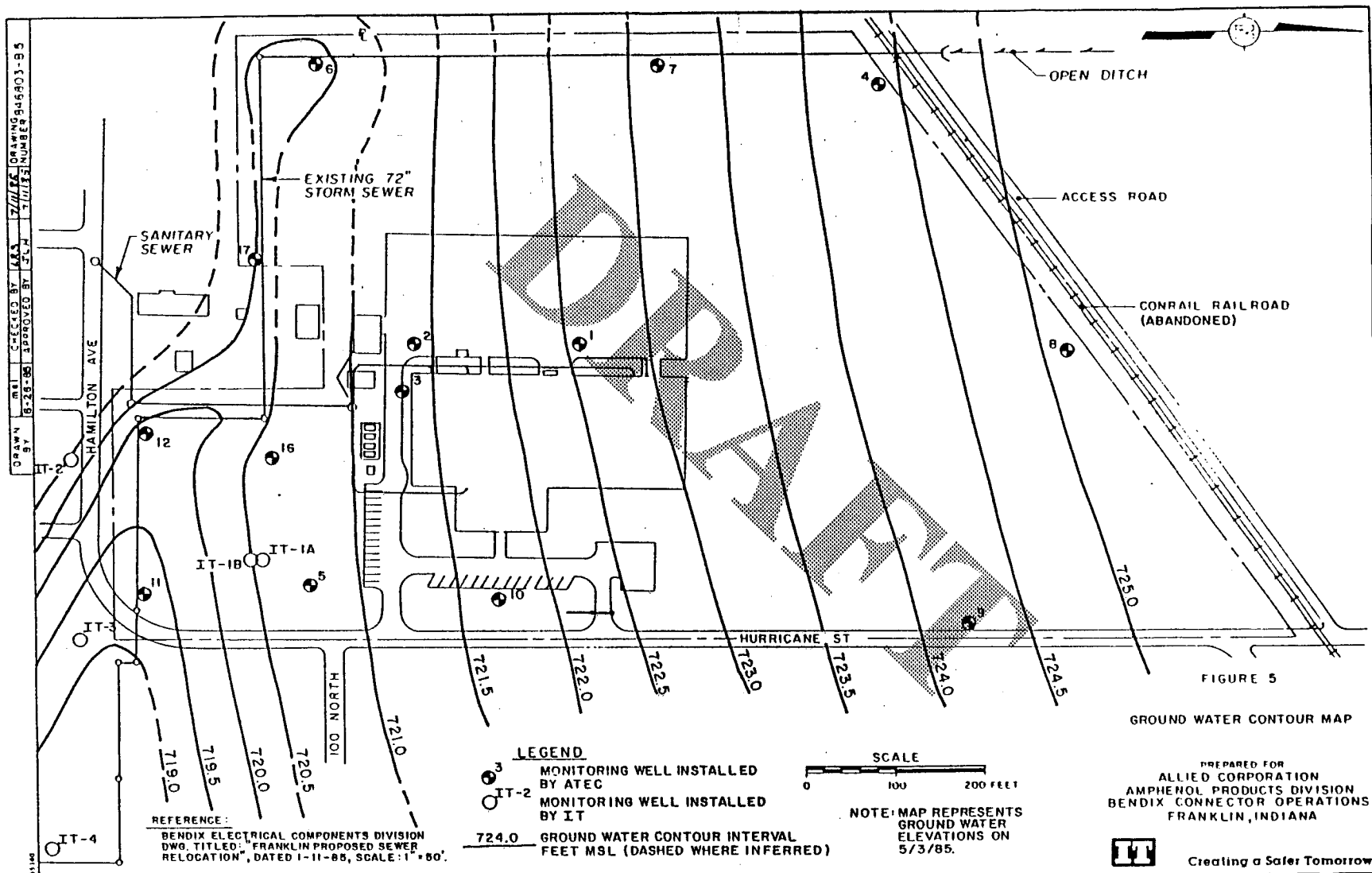


Figure 6. Unit B potentiometric contour map, May, 1985 (modified from IT, 1985).

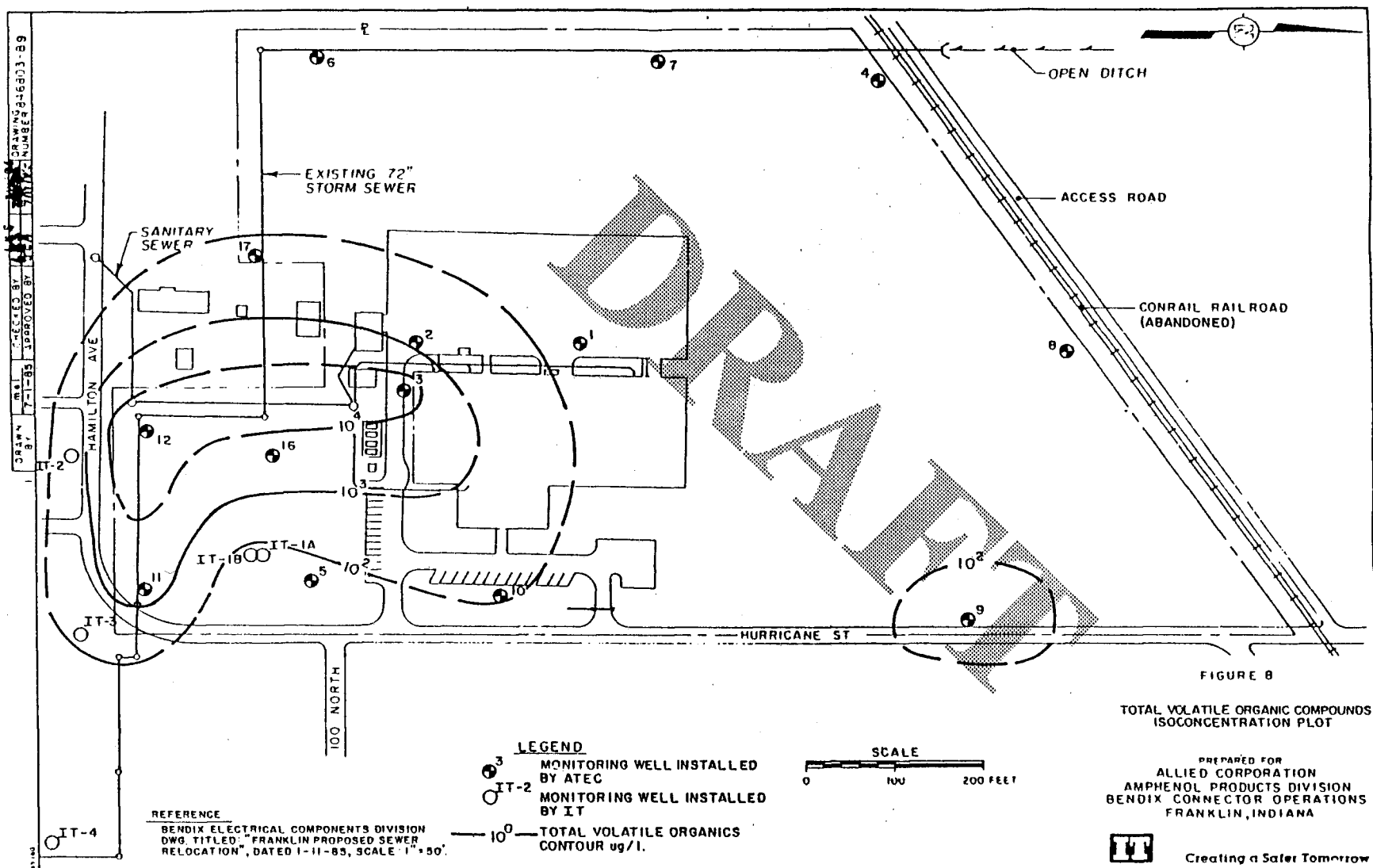


Figure 7. Isoconcentration map of VOCs in ground water, 1985 data (modified from IT.1985).

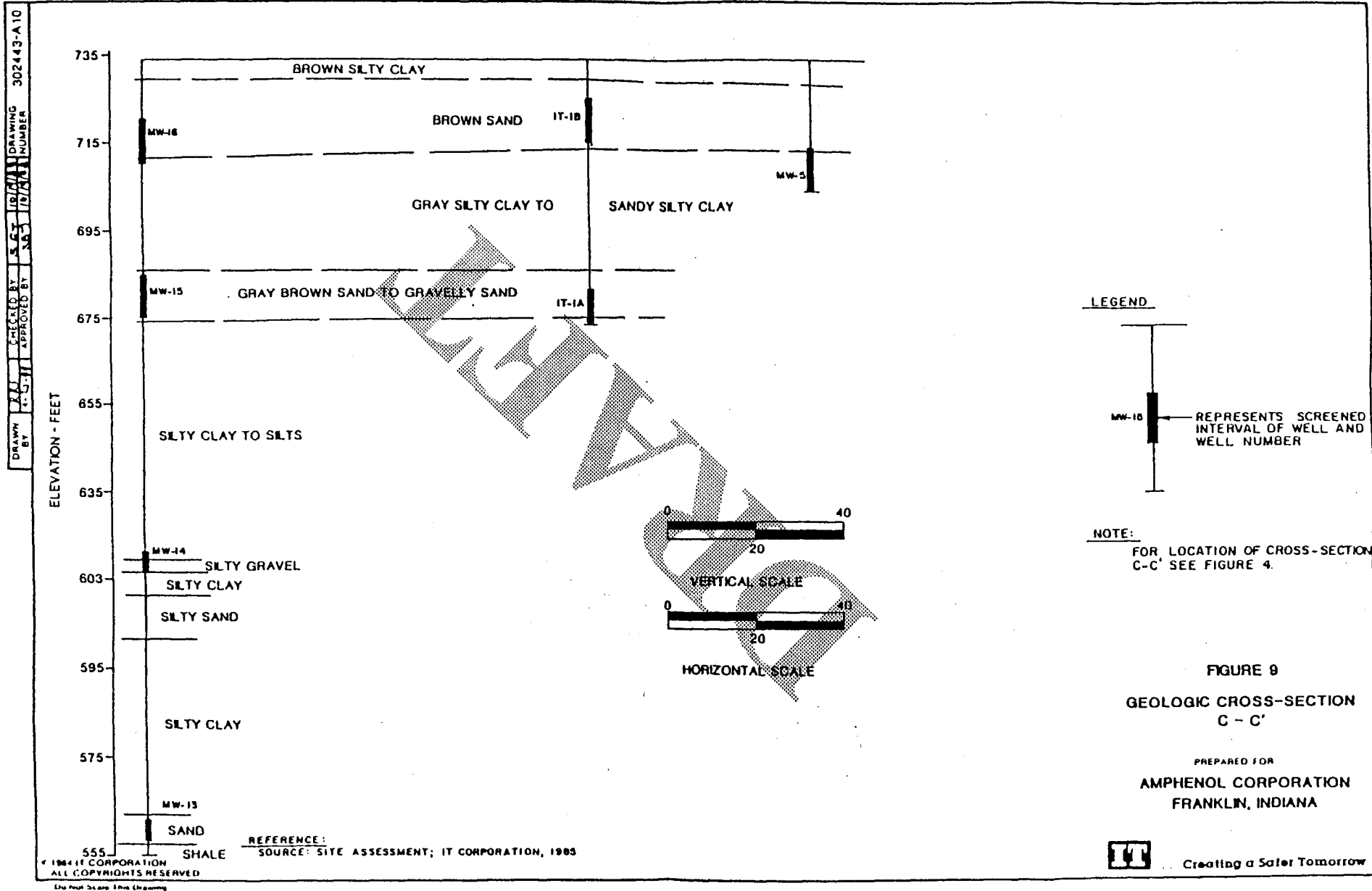
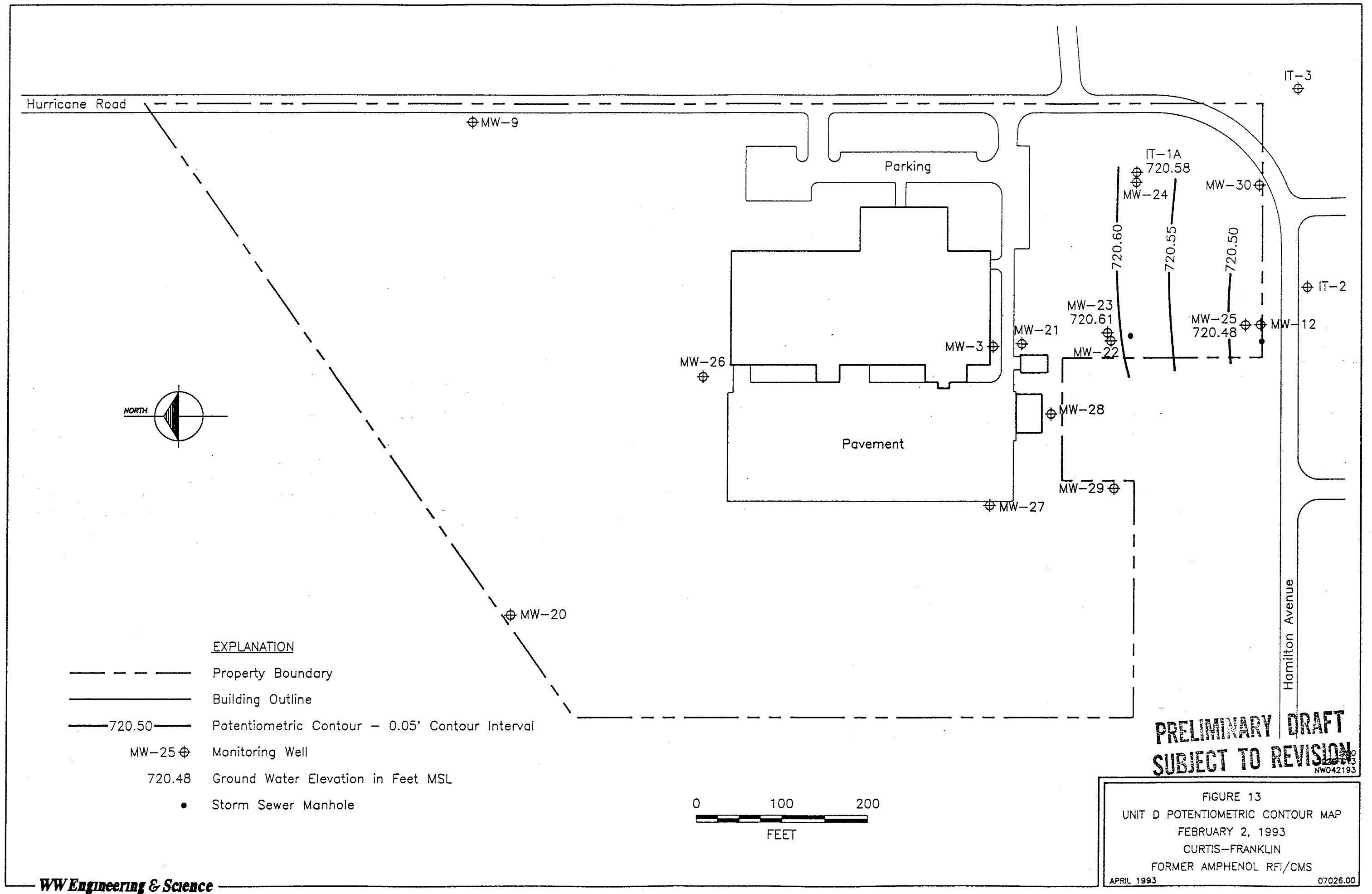
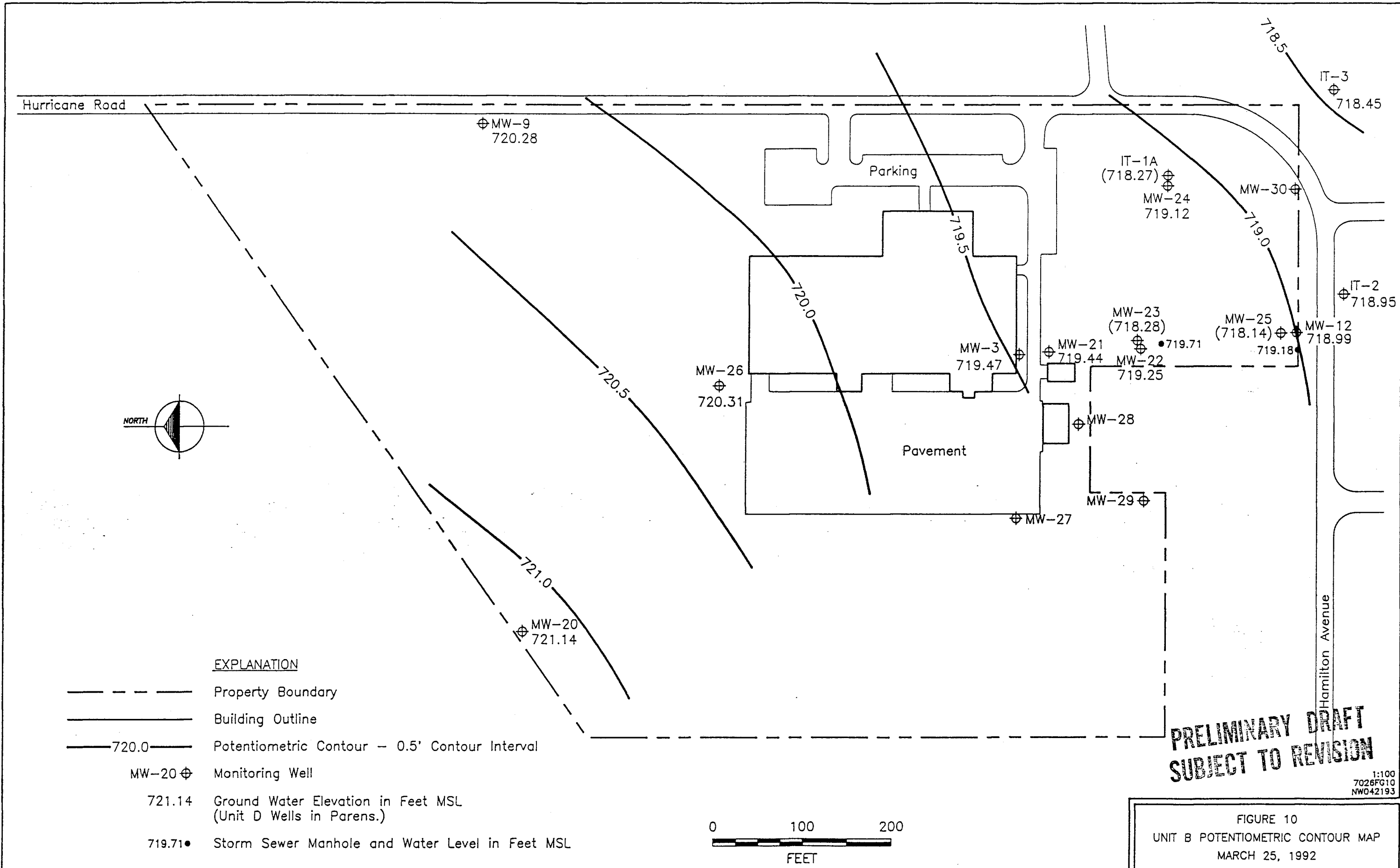


Figure 8. Geologic cross section based on 1984-1985 soil boring data (modified from IT, 1985).





**PRELIMINARY DRAFT
SUBJECT TO REVISION**

FIGURE 10
UNIT B POTENTIOMETRIC CONTOUR MAP
MARCH 25, 1992
CURTIS-FRANKLIN
FORMER AMPHENOL RFI/CMS
APRIL 1993 07026.00

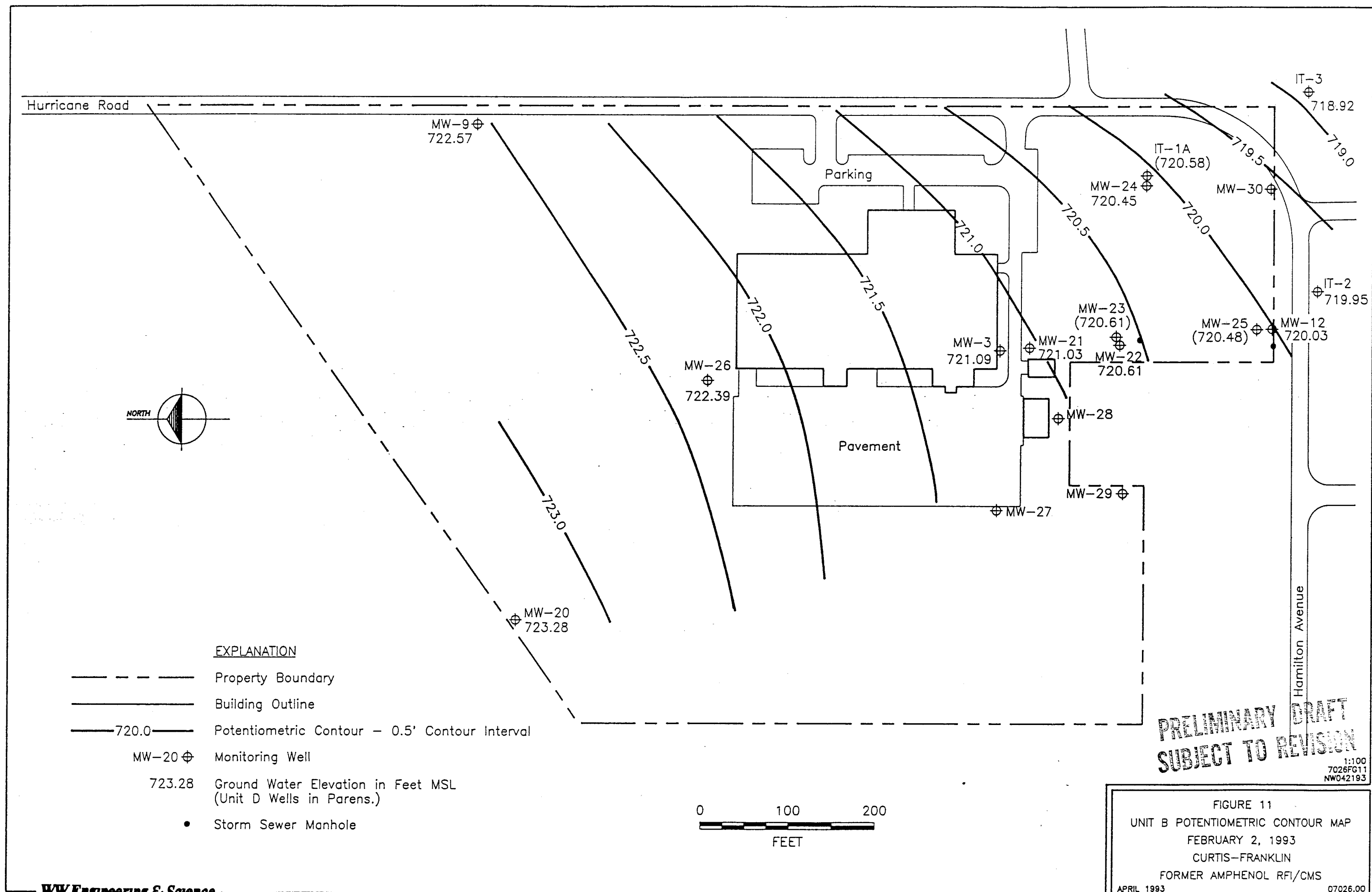
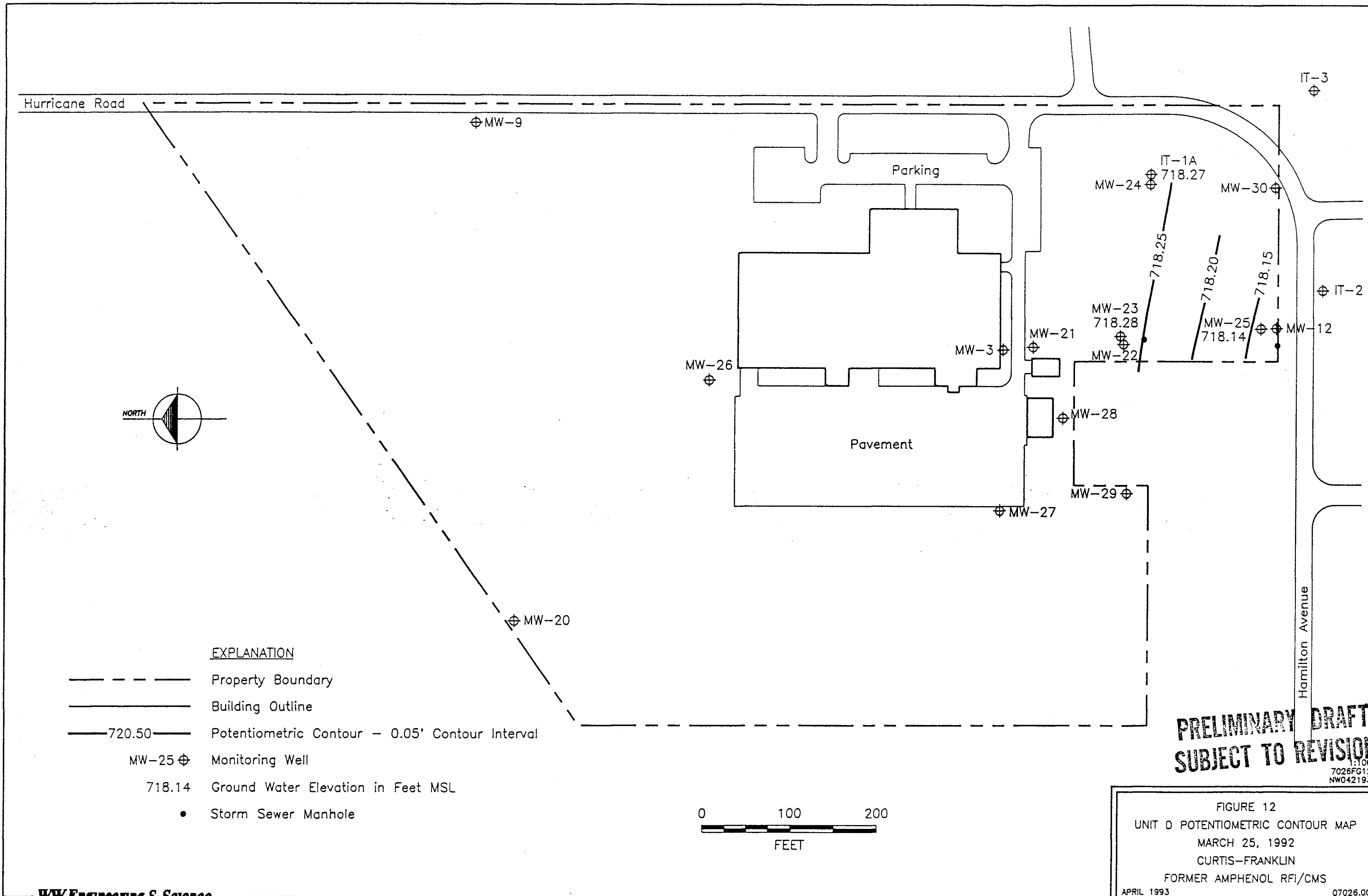


FIGURE 11
 UNIT B POTENTIOMETRIC CONTOUR MAP
 FEBRUARY 2, 1993
 CURTIS-FRANKLIN
 FORMER AMPHENOL RFI/CMS
 APRIL 1993 07026.00



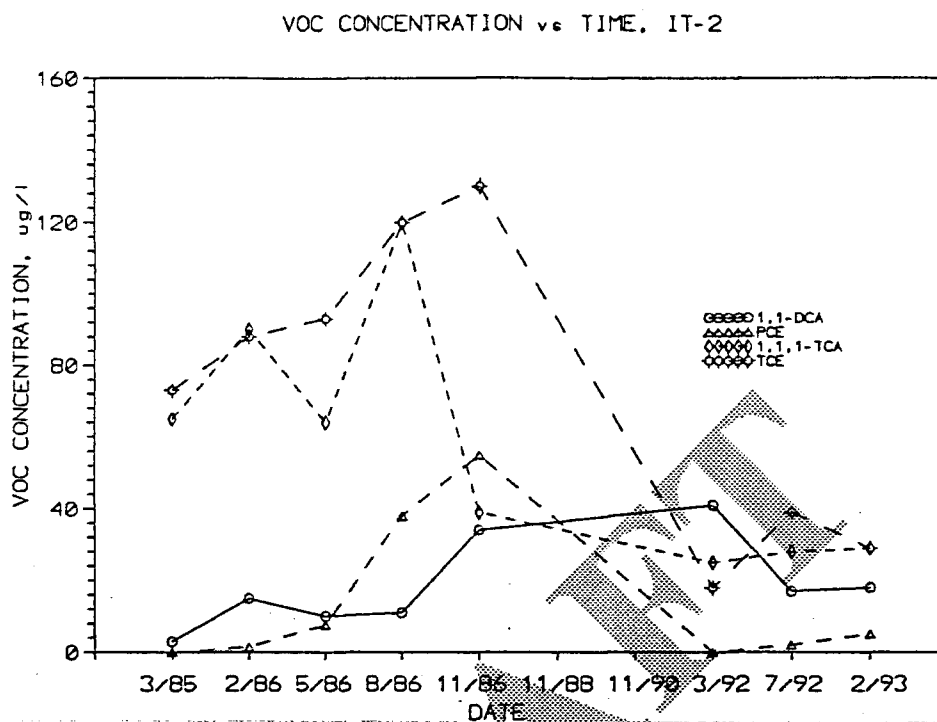


Figure 14a. Plot of VOC concentrations vs time for monitoring well IT-2.

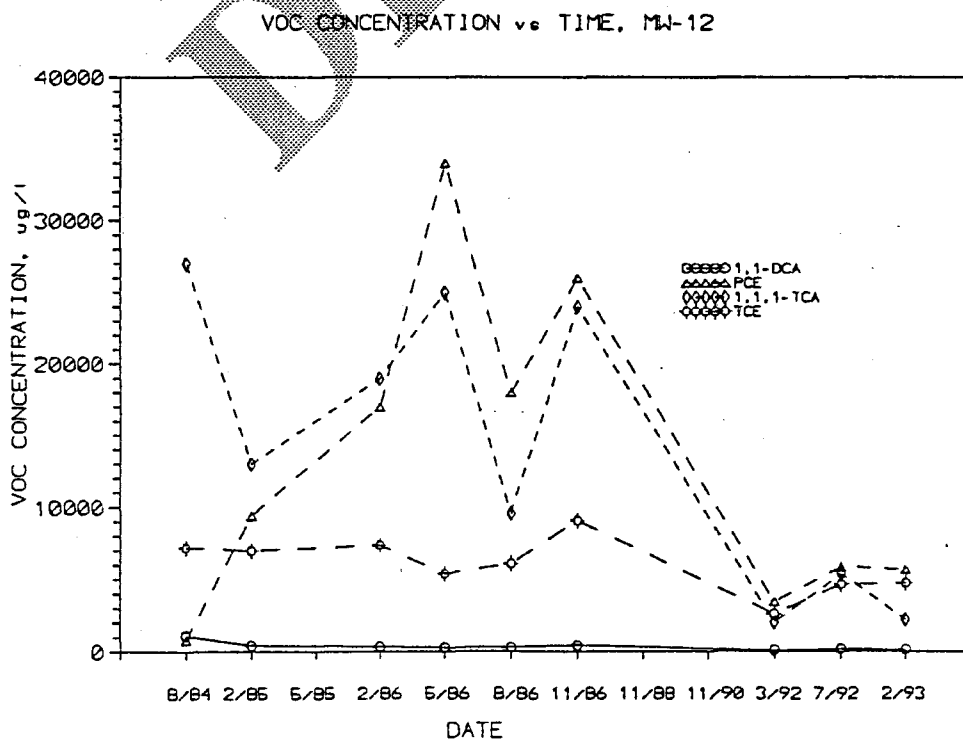


Figure 14b. Plot of VOC concentrations vs time for monitoring well MW-12.

Table 1. Water Elevation Data.

WELL NUMBER	STATIC WATER LEVEL (elev, feet MSL)						LITHO- STRATIGRAPHIC UNIT
	25-Mar 1992	02-Jun 1992	23-Jul 1992	07-Jan 1993	02-Feb 1993	16-Feb 1993	
IT-1A	718.27	717.47	717.29	720.10	720.58	720.76	D
IT-2	718.95	719.52	719.75	ND	719.95	719.78	B
IT-3	718.45	718.69	718.90	ND	718.92	716.96	B
MW-3	719.47	720.40	720.68	720.67	721.09	720.88	B
MW-9	720.28	721.57	721.87	ND	722.57	722.41	B
MW-12	718.99	719.62	719.87	ND	720.03	719.89	B
MW-20	721.14	722.52	722.80	ND	723.28	723.04	B
MW-21	719.44	720.31	720.62	720.60	721.03	720.81	B
MW-22	719.25	720.08	720.32	720.31	720.61	720.43	B
MW-23	718.28	717.51	717.33	720.05	720.61	720.73	D
MW-24	719.12	719.80	720.00	720.06	720.45	720.21	B
MW-25	718.14	717.35	717.16	720.08	720.48	720.62	D
MW-26	720.31	721.57	721.89	722.01	722.39	722.21	B
MW-27					721.19	720.96	B
MW-28					720.93	720.71	B
MW-29					720.78	720.53	B
MW-30					719.50	719.36	B
N Storm Sewer MH	719.71	719.71	ND	ND	ND	ND	NA
S Storm Sewer MH	719.18	719.15	ND	ND	ND	ND	NA
E Storm Sewer MH	ND	718.00	ND	ND	ND	ND	NA

T.O.C.=Top of Casing

NA=Not Applicable

ATEC=ATEC Associates, Indianapolis, IN

IT=IT Corporation, Pittsburgh, PA

WWES=WW Engineering & Science, Bloomington, IN

MW-27 through MW-30 installed January 13-15, 1993.

ND=not determined

D=decommissioned

U=not used in the RFI

Table 2. Soil Samples Selected for Chemical Analyses.

SOIL BORING	SAMPLE DEPTH	SAMPLE NUMBER	COLLECTION METHOD
SB-01	8.0-10.0	FCR-SB-SB01-10.0-01	Hand Auger
	10.0-12.0	FCR-SB-SB01-12.0-01	Hand Auger
SB-02	8.0-10.0	FCR-SB-SB02-10.0-01	Hand Auger
SB-03	4.0- 6.0	FCR-SB-SB03-6.0-01	HSA/3" Split Spoon
	8.0-10.0	FCR-SB-SB03-10.0-01	HSA/3" Split Spoon
SB-04	4.0- 6.0	FCR-SB-SB04-6.0-01	HSA/3" Split Spoon
	8.0-10.0	FCR-SB-SB04-10.0-01	HSA/3" Split Spoon
SB-05	0.0- 2.0	FCR-SB-SB05-2.0-01	HSA/3" Split Spoon
SB-06	6.0- 8.0	FCR-SB-SB06-8.0-01	HSA/3" Split Spoon
	15.0-17.0	FCR-SB-SB06-17.0-01	HSA/3" Split Spoon
SB-07	6.0- 8.0	FCR-SB-SB07-8.0-01	HSA/3" Split Spoon
	16.0-18.0	FCR-SB-SB07-18.0-01	HSA/3" Split Spoon
SB-08	0.0- 2.0	FCR-SB-SB08-2.0-01	HSA/3" Split Spoon
	17.0-19.0	FCR-SB-SB08-19.0-01	HSA/3" Split Spoon
SB-09	10.0-12.0	FCR-SB-SB09-12.0-01	HSA/3" Split Spoon
	16.0-18.0	FCR-SB-SB09-16.0-01	HSA/3" Split Spoon
MW-20	4.0- 6.0	FCR-SB-MW20-6.0-01	HSA/3" Split Spoon
	10.0-12.0	FCR-SB-MW20-12.0-01	HSA/3" Split Spoon
MW-21	10.0-12.0	FCR-SB-MW21-12.0-01	HSA/3" Split Spoon
	16.0-18.0	FCR-SB-MW21-18.0-01	HSA/3" Split Spoon
MW-22	8.0-10.0	FCR-SB-MW22-10.0-01	HSA/3" Split Spoon
	17.0-19.0	FCR-SB-MW22-19.0-01	HSA/3" Split Spoon
MW-22A	0.0- 2.0	FCR-SB-MW22A-2.0-01	HSA/3" Split Spoon
MW-23	19.5-21.5	FCR-SB-MW23-21.5-01	HSA/3" Split Spoon
MW-24	4.0- 6.0	FCR-SB-MW24-6.0-01	HSA/3" Split Spoon
	13.0-15.0	FCR-SB-MW24-15.0-01	HSA/3" Split Spoon
MW-25	8.0-10.0	FCR-SB-MW25-10.0-01	HSA/3" Split Spoon
	33.0-35.0	FCR-SB-MW25-35.0-01	HSA/3" Split Spoon
MW-26	4.0- 6.0	FCR-SB-MW26-6.0-01	HSA/3" Split Spoon
	10.0-12.0	FCR-SB-MW26-12.0-01	HSA/3" Split Spoon
MW-27	13.0-15.0	FCR-SB-MW27-15.0-03	HSA/3" Split Spoon
	25.0-27.0	FCR-SB-MW27-27.0-03	HSA/3" Split Spoon

HSA=Hollow Stem Auger

Table 3. RFI Soil Analytical Data.

	SB01-10.0	SB01-12.0	SB02-10.0	SB03-6.0	SB03-10.0
Inorganics (mg/kg)					
Aluminum	6,850*	1,860*	3,180*	18,200	6,130
Antimony	7.30UN	12.3BN	7.60UN	9.20B	7.30U
Arsenic	6.30	4.60	5.90	9.50NS	7.30NS
Barium	34B	8.60B	12.40B	113	29.60B
Beryllium	4.81B	1.12	1.10B	0.62B	0.45B
Cadmium	0.66U	0.63U	0.69U	0.72U	0.67U
Calcium	51,400E	101,000E	99,200E	1,980	19,300
Chromium	8.50	1.10U	1.80B	19.40	10.5
Cobalt	3.90B	2.70B	3.60B	9.30B	5.20B
Copper	516.0	1,970	65.10	12.70	14.80
Cyanide (amenable)	17.8	17.4	0.8	<0.5	<0.5
Cyanide (total)	21.6	20.5	0.94	<0.5	<0.5
Iron	11,700*	6,030*	8,460*	23,000	12,400
Lead	9.3S	5.10	5.90	17	11.90
Magnesium	13,200	30,000	29,100	3,120	11,900
Manganese	417*	225*	267.0*	554	574
Mercury	0.11U	0.11U	0.11U	0.12UN	0.11UN
Nickel	12.90	5.50B	9.70	17.50	20.9
Potassium	1,090B	412B	622B	1,470	748B
Selenium	0.66UN	0.63UN	0.69UN	0.48UN	0.44UN
Silver	1.80U	1.70U	1.80U	1.90U	1.80U
Sodium	101U	96.20U	104U	109U	102B
Thallium	0.44UW	0.42UW	0.46UW	0.72U	0.67U
Vanadium	16.10	6.90B	10.8B	33.80	14.30
Zinc	43.90*	27.70*	31.8	58.30	44.90
Volatile Organics (ug/kg)					
Acetone	27U	27U	35B	23	11U
2-Butanone	27U	27U	27U	12U	11U
Carbon tetrachloride	13U	13U	13U	6U	5U
Chloroform	13U	13U	13U	6U	5U
1,1-Dichloroethane	13U	13U	13U	6U	5U
1,1-Dichloroethylene	NA	NA	NA	NA	NA
1,2-Dichloroethene (total)	13U	13U	13U	6U	5U
1,2-Dichloropropane	13U	13U	13U	6U	5U
Ethylbenzene	13U	13U	13U	6U	5U
Methylene Chloride	64	77	63	8	18
Tetrachloroethene	390	310	370	6U	60
Toluene	13U	13U	13U	6U	5U
1,1,1-Trichloroethane	29	23	26	6U	15
Trichloroethene	140	120	140	6U	52
Xylenes	13U	13U	13U	6U	5U

NA = Not Analyzed

Table 3, Continued.

	SB04-6.0	SB04-10.0	SB04-10.0	SB05-2.0	SB06-8.0-01
Inorganics (mg/kg)			DUPLICATE		
Aluminum	8,520	4,140	3,520	12,400*	2,760*
Antimony	8.60B	8.10B	10.50B	7.70U	6.80U
Arsenic	5.50NS	4.30N	4.10NS	5.9NS	4.20N
Barium	89.1	19.30B	15.90B	115	12.10B
Beryllium	0.75B	0.89B	0.90B	0.70B	0.49B
Cadmium	0.71U	0.67U	0.68U	0.70U	0.62U
Calcium	28,000	78,400	80,200	2,540	35,400
Chromium	10.0	10.70	5.00	14.4	4.9
Cobalt	5.50B	5.15B	3.80B	11.2B	3.6B
Copper	12.4	12.60	12.70	14.6	9.3
Cyanide (amenable)	<0.5	<0.5	<0.5	<0.5	<0.5
Cyanide (total)	<0.5	<0.5	<0.5	0.58U	0.52U
Iron	12,700	9,100	7,790	14,700	7,160
Lead	34	7.40	7.30	20.5	4.2
Magnesium	10,500	31,800	42,600	1,970	10,900
Manganese	80B	521	215	1,000	235
Mercury	0.12UN	0.11UN	0.11UN	0.12U	0.10U
Nickel	12.4	12	7.60B	14.8	8.20B
Potassium	822B	466B	587B	1,310	370B
Selenium	0.47UN	0.45U	0.45UN	0.47UN	0.41N
Silver	1.90U	1.80U	1.80U	1.90U	1.70U
Sodium	111B	126B	116B	106U	94.10U
Thallium	0.71U	0.67U	0.68U	0.47UNW	0.41U
Vanadium	18.20	10.40B	9.20B	28.0	7.50B
Zinc	45.10	33.10	25.40	53.3	23.30
Volatile Organics (ug/kg)					
Acetone	21	11J	13	4J	12
2-Butanone	12U	11U	11U	12U	11U
Carbon tetrachloride	6U	6U	6U	6U	5U
Chloroform	6U	6U	6U	6U	5U
1,1-Dichloroethane	6U	6U	6U	6U	5U
1,1-Dichloroethylene	NA	NA	NA	NA	NA
1,2-Dichloroethene (total)	6U	6U	6U	6U	5U
1,2-Dichloropropane	6U	6U	6U	6U	5U
Ethylbenzene	6U	6U	6U	6U	5U
Methylene Chloride	11	18	2J	6U	16
Tetrachloroethene	2J	16	6	2J	25
Toluene	NA	6U	6U	6U	5U
1,1,1-Trichloroethane	6U	8	3J	6U	5U
Trichloroethene	6U	10	5J	6U	7
Xylenes	6U	6U	6U	6U	5U

NA = Not Analyzed

Table 3, Continued.

	SB06-8.0	SB06-17.0	SB07-8.0	SB07-18.0	SB08-2.0
Inorganics (mg/kg)	DUPLICATE				
Aluminum	4,950*	1,760*	1,580E	2,520E	11,000*
Antimony	6.80U	7.50U	3.60UN	3.60UN	7.60U
Arsenic	5.40NS	2.2BN	2.50W	1.70B	3.80N
Barium	21.80B	7.0B	7.60B	8.50B	105
Beryllium	0.29B	1.1B	0.21U	0.21U	0.62B
Cadmium	0.62U	0.68U	0.42UN	0.43UN	0.69U
Calcium	1,610	109,000	77,000	138,000	1,980
Chromium	8.70	1.10U	4.20*	6.50*	13.40
Cobalt	4.10B	2.60B	1.40B	1.50B	2.60B
Copper	11.9	7.40	19.10	18.00	9.30
Cyanide (amenable)	<0.5	<0.5	<0.5	<0.5	<0.5
Cyanide (total)	0.52U	0.57U	<0.5	<0.5	0.57U
Iron	9,430	4,390	4,520E	5,420E	13,700
Lead	6.0	3.70S	3.40NW*	6.40N*+	15.20
Magnesium	1,800	26,500	17,100	43,800	1,990
Manganese	325	189	174EN*	165EN*	754
Mercury	0.10U	0.11U	0.11U	0.11U	2.30
Nickel	11.3	4.40B	5.20B	6.30B	13.50
Potassium	710B	426B	228B	516B	939B
Selenium	0.41UN	0.5UNW	0.42U	0.43UW	0.46UN
Silver	1.60U	1.8U	0.42U	0.45B	1.80U
Sodium	93.80U	104U	171B	271B	105U
Thallium	0.41	0.45U	0.42U	0.43U	0.46UW
Vanadium	11.40	5.1B	5.60B	10.50B	21.80
Zinc	31.40	14.2	15.40	19.50B	42.7
Volatile Organics (ug/kg)					
Acetone	10U	59U	26U	1,300U	11U
2-Butanone	10U	59U	13U	1,300U	11U
Carbon tetrachloride	5U	29U	13U	670U	6U
Chloroform	5U	29U	13U	670U	6U
1,1-Dichloroethane	5U	29U	13U	670U	6U
1,1-Dichloroethylene	NA	NA	NA	NA	NA
1,2-Dichloroethene (total)	5U	29U	13U	670U	6U
1,2-Dichloropropane	5U	29U	13U	670U	6U
Ethylbenzene	5U	29U	13U	670U	6U
Methylene Chloride	5U	84	13U	670U	6U
Tetrachloroethene	37	1,100	330	17,000	53
Toluene	5U	29U	13U	670U	6U
1,1,1-Trichloroethane	1J	140	13U	670U	6U
Trichloroethene	17	720	19	440J	17
Xylenes	5U	29U	13U	670U	6U

NA = Not Analyzed

Table 3, Continued.

	SB08-19.0	SB09-12.0	SB09-18.0	SB09-18.0	MW20-6.0
Inorganics (mg/kg)				DUPLICATE	
Aluminum	2,420*	2,970E	2,160E	2,370E	15,200
Antimony	7.40U	3.60UN	4.20UN	4UN	7.90U
Arsenic	2.80N	3.80	2.20B	2.20BS	4.10NS
Barium	9.30B	10.50B	7.60	8.60B	83.10
Beryllium	1.20	0.21U	0.25U	0.24U	0.84B
Cadmium	0.67U	2.40N	2.50N	13.20N	0.72U
Calcium	115,000	88,800	105,000	103,000	4,180
Chromium	1.90B	7.10*	12.80*	11.90*	20.70
Cobalt	3.00B	1.90B	1.90B	1.60B	5.40B
Copper	13.70	19.40	106	137.0	14.0
Cyanide (amenable)	<0.5	<0.5	<0.5	18.4	<0.5
Cyanide (total)	0.56U	<0.5	<0.5	18.4	<0.5
Iron	6,280	6,480E	5,500E	5,980E	20,100
Lead	5.50	5.10N*	4.30NS*	5.90N*	16.5
Magnesium	26,400	31,800	26,800	28,500	3,820
Manganese	188	235.0EN*	165EN*	181EN*	350
Mercury	0.11U	0.11U	0.12U	0.12U	0.11UN
Nickel	8.30B	9.90	30.50	35.30	17.1
Potassium	510B	560B	372B	360.0B	1,120B
Selenium	0.45UN	0.42UW	0.50UW	0.47UW	0.48UN
Silver	1.80U	0.42U	0.50U	1.20B	1.90U
Sodium	102U	244B	219B	224B	109U
Thallium	0.45U	0.42	0.50U	0.47U	0.72U
Vanadium	8.00B	10.0B	7.70B	8.20B	27.80
Zinc	33.9	21.60	80.60	88.40	77.30
Volatile Organics (ug/kg)					
Acetone	680J	54U	1,500U	1,400U	9J
2-Butanone	2,900U	27U	1,500U	1,400U	10U
Carbon tetrachloride	1,400U	27U	740U	690U	5U
Chloroform	1,400U	27U	740U	690U	5U
1,1-Dichloroethane	1,400U	27U	740U	690U	5U
1,1-Dichloroethylene	NA	NA	NA	NA	NA
1,2-Dichloroethene (total)	1,400U	27U	740U	690U	5U
1,2-Dichloropropane	1,400U	27U	740U	690U	5U
Ethylbenzene	1,400U	27U	740U	690U	5U
Methylene Chloride	510BJ	27U	740U	690U	5U
Tetrachloroethene	36,000	550	15,000	10,000.0	5U
Toluene	1,400U	27U	740U	690U	3J
1,1,1-Trichloroethane	270J	10J	650J	690J	5U
Trichloroethene	3,100	150	3,500	2,500	5U
Xylenes	1,400U	27U	740U	690U	5U

NA = Not Analyzed

Table 3, Continued.

	MW20-12.0	MW21-12.0	MW21-12.0	MW21-18.0	MW22A-2.0
Inorganics (mg/kg)			DUPLICATE		
Aluminum	2,220	2,610E	2,380E	1,990E	6,890*
Antimony	7.40U	3.60UN	3.60UN	4.10UN	7.50U
Arsenic	2.60NS	3.20	4.60	2.30B	7.40N
Barium	26.6B	8.80B	15.20B	6.10B	58.70
Beryllium	0.49B	0.21U	0.21B	0.24U	0.96B
Cadmium	0.67U	0.42UN	0.42UN	0.48UN	0.68U
Calcium	37,600	146,000	139,000	91,200.0	66,300
Chromium	3.70	7.80*	6.30*	6.00*	6.20
Cobalt	3.40B	1.80B	1.80B	2.10B	8.20B
Copper	11.20	16.50	21.0	27.40	14.2
Cyanide (amenable)	<0.5	1.0	<0.5	<0.5	<0.5
Cyanide (total)	<0.5	1.0	<0.5	<0.5	<0.5
Iron	6,770.0	5,950E	6,580.0E	5,440.0E	11,800.0
Lead	6.70	11.40NS*	4.80N*	3.30N*	52.90W
Magnesium	20,100.0	47,900	59,900	24,400	17,110
Manganese	226.0	241.0EN*	426EN*	137EN*	491
Mercury	0.11UN	0.10U	0.11U	0.12U	0.11U
Nickel	9.10	8.30B	11.10	15.80	10.5
Potassium	400.0B	528B	479B	267B	811B
Selenium	0.45UN	0.42UW	0.42UW	0.48UW	0.45UN
Silver	1.80U	0.42U	0.42U	0.48U	1.80U
Sodium	117.0B	281B	238B	203B	103U
Thallium	0.67U	0.42U	0.42UW	0.48U	0.45U
Vanadium	7.60B	9.80B	9.10B	7.20B	16.0
Zinc	25.0	18.90	25.90	23.10	91.0
Volatile Organics (ug/kg)					
Acetone	9U	53U	53U	1,500U	6BU
2-Butanone	10U	53U	53U	1,500U	11U
Carbon tetrachloride	5U	26U	27U	740U	6U
Chloroform	5U	26U	27U	740U	6U
1,1-Dichloroethane	5U	26U	27U	740U	6U
1,1-Dichloroethylene	NA	NA	NA	NA	NA
1,2-Dichloroethene (total)	5U	26U	27U	740U	6U
1,2-Dichloropropane	5U	26U	27U	740U	6U
Ethylbenzene	5U	26U	27U	740U	6U
Methylene Chloride	5U	26U	27U	740U	6U
Tetrachloroethene	5U	780	160	25,000	36
Toluene	5	26U	27U	740U	6U
1,1,1-Trichloroethane	5U	26U	27U	750	6U
Trichloroethene	5U	300	52	5,300	2U
Xylenes	5U	26U	27U	740U	6U

NA = Not Analyzed

Table 3, Continued.

	MW22-10.0	M22-19.0	MW23-21.5	MW24-6.0	MW24-15.0
Inorganics (mg/kg)					
Aluminum	2,970*	2,300*	5,650*	1,400	2,850
Antimony	12.4B	7.50U	7.10U	6.80U	10.70B
Arsenic	8.3N	2.20BN	5.00N	2.00N	1.90NS
Barium	11.5B	8.20B	38.4B	5.9B	13.3B
Beryllium	1.50	1.00B	1.10	0.80B	1.2
Cadmium	0.63U	0.68U	0.65U	0.62U	0.63U
Calcium	163,000	102,000	93,000	66,900	106,000
Chromium	1.00U	1.10U	3.60	1.00U	1.60B
Cobalt	5.50B	3.20B	8.20B	2.10B	3.70B
Copper	11.90	15.70	13.70	5.90	15.30
Cyanide (amenable)	<0.5	<0.5	<0.5	<0.5	<0.5
Cyanide (total)	<0.5	<0.5	<0.5	<0.5	<0.5
Iron	10,800	5,450	9,130	4,090	8,360
Lead	11.20	4.10S	11.10S	4.70	10.9
Magnesium	43,500	28,000	27,500	16,900	29,600
Manganese	290	189	292	145	229
Mercury	0.10U	0.11U	0.11U	0.10UN	0.10UN
Nickel	8.20B	6.30B	13.2	4.40B	9.40
Potassium	721B	512.0B	1,250	238B	568B
Selenium	0.4UNW	0.5UNW	0.4UNW	0.41UN	0.42UN
Silver	1.70U	1.80U	1.70U	1.70U	1.70U
Sodium	146B	104U	98.20U	94U	116B
Thallium	0.42U	0.46U	0.43U	0.62U	0.63U
Vanadium	10.40	7.10B	13.40	3.80B	8.20B
Zinc	33.60	22.90	35	16.50	28.70
Volatile Organics (ug/kg)					
Acetone	27U	12,000U	1300U	10U	19
2-Butanone	27U	12,000U	1300U	10U	11U
Carbon tetrachloride	13U	6,200U	670U	5U	5U
Chloroform	13U	6,200U	670U	5U	5U
1,1-Dichloroethane	13U	6,200U	3,100	5U	5U
1,1-Dichloroethylene	NA	NA	NA	NA	NA
1,2-Dichloroethene (total)	13U	6,200U	670U	5U	5U
1,2-Dichloropropane	13U	6,200U	670U	5U	5U
Ethylbenzene	13U	6,200U	670U	5U	5U
Methylene Chloride	13U	13,000.0B	1,500	2J	27
Tetrachloroethene	300	120,000	280J	2J	6
Toluene	13U	6,200	670U	5U	5U
1,1,1-Trichloroethane	13U	6,200U	390J	5U	10
Trichloroethene	43	1,600J	460J	5U	38
Xylenes	13U	6,200U	670U	5U	5U

NA = Not Analyzed

ME/123/7026/2/TABLE5

Table 3, Continued.

	MW25-10.0	MW25-35.0	MW26-6.0	MW26-12.0	MW-27-15.0
Inorganics (mg/kg)					
Aluminum	2,580*	6,100E	12,500	2,440	1960
Antimony	8.50B	3.80UN	7.60U	10.40B	6.4UN
Arsenic	6.3N	5.00S	6.70N	2.20NS	0.65BMN
Barium	10.6B	59.70	49.80	15.90B	7.9B
Beryllium	1.50	0.39B	0.57B	0.97B	1.1
Cadmium	0.63U	0.44UN	0.69U	0.64U	0.44U
Calcium	143,000	111,000	1,620	94,700	91200
Chromium	1.10U	11.4*	15.80	1.10U	4.0
Cobalt	4.80B	5.00B	5.00B	3.30B	1.8B
Copper	10.10	35.80	22.80	10.90	22.2*
Cyanide (amenable)	<0.5	<0.5	<0.5	<0.5	<0.5
Cyanide (total)	0.53U	<0.5	<0.5	<0.5	0.55U
Iron	8,400	12,800E	20,500	6,050	4470
Lead	12	9.00NW*	20.30	4.80	3.6*
Magnesium	39,200	37,400	2,560	33,500	22400
Manganese	303	328EN*	687	217	149
Mercury	0.11U	0.11U	0.12UN	0.11UN	0.11U
Nickel	6.20B	19.40	18.90	6.40B	7.5B
Potassium	399B	1,390	921B	540B	435B
Selenium	0.44BMNW	0.44U	0.46UN	0.43UN	0.22UW
Silver	1.70U	0.44U	1.80U	1.70U	1.4B
Sodium	95.60U	275B	105U	142B	111U
Thallium	0.42U	0.44U	0.69U	0.64U	0.66UN
Vanadium	9.5B	15.60	24.3	6.90B	6.6B
Zinc	30	44.50	56.2	22.90	16.0*
Volatile Organics (ug/kg)					
Acetone	10U	20	19	28	680BJ
2-Butanone	10U	11U	11U	11U	1400U
Carbon tetrachloride	5U	5U	6U	5U	1400U
Chloroform	5U	5U	6U	5U	1400U
1,1-Dichloroethane	5U	5U	6U	5U	1400U
1,1-Dichloroethylene	NA	NA	NA	NA	1400U
1,2-Dichloroethene (total)	5U	5U	6U	5U	1400U
1,2-Dichloropropane	5U	5U	6U	5U	1400U
Ethylbenzene	5U	5U	6U	5U	1400U
Methylene Chloride	5U	41	6U	5U	660J
Tetrachloroethene	44	12	6U	5U	1700C
Toluene	5U	5U	6U	5U	1400U
1,1,1-Trichloroethane	5U	5U	6U	5U	1400U
Trichloroethene	46	5U	6U	5U	1400U
Xylenes	5U	5U	6U	5U	1400U

NA = Not Analyzed

ME/123/7026/2/TABLE5

Table 3, Continued.

	MW27-15.0	MW27-23.0	PGP15-11.0	PGP16-11.0	PGP16-11.0
Inorganics (mg/kg)	DUPLICATE				DUPLICATE
Aluminum	1902	2100	NA	NA	NA
Antimony	6.4U	9.7UN	NA	NA	NA
Arsenic	0.72B	0.65BN	NA	NA	NA
Barium	8.4B	8.8B	NA	NA	NA
Beryllium	1.2	1.5	NA	NA	NA
Cadmium	0.44U	0.49B	NA	NA	NA
Calcium	9345	80600	NA	NA	NA
Chromium	.3	3.5	NA	NA	NA
Cobalt	1.8B	1.2U	NA	NA	NA
Copper	102	70.7*	NA	NA	NA
Cyanide (amenable)	<0.5	<0.5	NA	NA	NA
Cyanide (total)	0.55U	0.58U	NA	NA	NA
Iron	4730	4490	NA	NA	NA
Lead	8.5	5.8*	NA	NA	NA
Magnesium	22135	21900	NA	NA	NA
Manganese	149	141	NA	NA	NA
Mercury	0.11U	0.12U	NA	NA	NA
Nickel	15.2	14.6	NA	NA	NA
Potassium	395B	411B	NA	NA	NA
Selenium	0.22U	0.27B	NA	NA	NA
Silver	1.8B	1.7B	NA	NA	NA
Sodium	111U	117U	NA	NA	NA
Thallium	0.66U	0.7UN	NA	NA	NA
Vanadium	5.7B	6.4B	NA	NA	NA
Zinc	53.1	30.9*	NA	NA	NA
Volatile Organics (ug/kg)					
Acetone	500BJ	59B	78UJ	11U	95
2-Butanone	390J	7J	11UJ	11U	11U
Carbon tetrachloride	1300U	12U	5UJ	5U	5U
Chloroform	1300U	3J	5UJ	5U	5U
1,1-Dichloroethane	1300U	12U	5UJ	5U	5U
1,1-Dichloroethylene	1300U	12U	5UJ	5U	5U
1,2-Dichloroethene (total)	1300U	12U	5UJ	5U	5U
1,2-Dichloropropane	1300U	12U	5UJ	5U	5U
Ethylbenzene	1300U	12U	4J	5U	5U
Methylene Chloride	1300U	2J	18UJ	6	29
Tetrachloroethene	25000	100	85J	5	9
Toluene	1300U	12U	7J	5U	5J
1,1,1-Trichloroethane	1300U	3J	5UJ	11	16
Trichloroethene	1300U	12U	10J	94	140
Xylenes	1300U	2J	34J	5U	5U

NA = Not Analyzed

Table 3, Continued.

	PGP18-11.0
Inorganics (mg/kg)	
Aluminum	NA
Antimony	NA
Arsenic	NA
Barium	NA
Beryllium	NA
Cadmium	NA
Calcium	NA
Chromium	NA
Cobalt	NA
Copper	NA
Cyanide (amenable)	NA
Cyanide (total)	NA
Iron	NA
Lead	NA
Magnesium	NA
Manganese	NA
Mercury	NA
Nickel	NA
Potassium	NA
Selenium	NA
Silver	NA
Sodium	NA
Thallium	NA
Vanadium	NA
Zinc	NA
Volatile Organics (ug/kg)	
Acetone	97
2-Butanone	11U
Carbon tetrachloride	5U
Chloroform	5U
1,1-Dichloroethane	5U
1,1-Dichloroethylene	5U
1,2-Dichloroethene (total)	5U
1,2-Dichloropropane	5U
Ethylbenzene	5U
Methylene Chloride	20
Tetrachloroethene	5U
Toluene	21
1,1,1-Trichloroethane	8
Trichloroethene	53
Xylenes	5U

NA = Not Analyzed

ME/123/7026/2/TABLE5

REVISED 6/94

Table 4. RFI Surface Water Field Chemistry Data.

Sample	Date	pH (Std. Units)	T (deg C)	SpC25 (umhos/cm)	DOX (mg/l YSI)	DOX (mg/k HACH)	Q (cfs)
SW-01	02/25/92	8.1	9.0	576	ND	ND	3.24
SW-01	02/27/92	8.3	14.0	555	ND	ND	ND
SW-01	03/25/92	ND	ND	ND	10.2	12	ND
SW-02	02/25/92	7.8	8.0	610	ND	ND	0.06
SW-02Dup	02/25/92	7.9	8.0	622	ND	ND	ND
SW-02	02/27/92	7.7	11.0	614	ND	ND	ND
SW-02	03/25/92	ND	ND	ND	11.4	13	ND
SW-02	07/27/92	8.6	.03	5718	ND	ND	0.35
SW-02	02/17/93	7.9	3.0	483	ND	ND	ND
SW-03	02/25/92	ND	ND	ND	ND	ND	3.76
SW-03	02/27/92	8.1	11.0	587	ND	ND	ND
SW-03	03/25/92	ND	ND	ND	11.9	11	ND
SW-04	02/25/92	ND	ND	ND	ND	ND	3.19
SW-04	02/27/92	8.3	11.0	587	ND	ND	ND
SW-04	03/25/92	ND	ND	ND	11.8	12	12
SW-05	02/25/92	7.7	7	617	ND	ND	ND
SW-05	02/27/92	7.9	13	597	ND	ND	0.111
SW-05	03/25/92	ND	ND	ND	13.2	14	ND

ND=Not Determined

DOX=Dissolved Oxygen

YSI=Yellow Springs Instruments DOX Meter

HACH=HACH Systems DOX Trilation Kit

cts=cubic feet/second

Table 5. RFI Surface Water Analytical Data.

Sample Number Date	SW-01 02/26/92	SW-02 02/26/92	SW-02d 02/26/92	SW-05 02/26/92	SW-02 07/27/92	SW-02 02/18/93	SW-02D 02/08/93	EQUIP BLANK 02/18/93	TRIP BLANK 02/26/92
Inorganics (ug/l)									
Aluminum	NA	NA	NA	NA	196NLB	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	39.0UNJ	NA	NA	NA	NA
Arsenic	NA	NA	NA	NA	1.7B	NA	NA	NA	NA
Barium	NA	NA	NA	NA	93.6B	NA	NA	NA	NA
Beryllium	NA	NA	NA	NA	1.2BJ	NA	NA	NA	NA
Cadmium	NA	NA	NA	NA	3.0U	NA	NA	NA	NA
Calcium	NA	NA	NA	NA	101000	NA	NA	NA	NA
Chromium	NA	NA	NA	NA	6.0U	NA	NA	NA	NA
Cobalt	NA	NA	NA	NA	5.0U	NA	NA	NA	NA
Copper	NA	NA	NA	NA	9.0U	NA	NA	NA	NA
Cyanide (amenable)	<0.5	<0.5	<0.5	<0.5	<10	<10	<10	<10	NA
Cyanide (total)	10.00U	10.00U	10.00U	10.00U	10U	10U	10U	10U	NA
Iron	NA	NA	NA	NA	251*J	NA	NA	NA	NA
Lead	NA	NA	NA	NA	1.0U	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	27700	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	25.1J	NA	NA	NA	NA
Mercury	NA	NA	NA	NA	0.2U	NA	NA	NA	NA
Nickel	NA	NA	NA	NA	7.0U	NA	NA	NA	NA
Potassium	NA	NA	NA	NA	3440B	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	2.0UJ	NA	NA	NA	NA
Silver	NA	NA	NA	NA	8.0U	NA	NA	NA	NA
Sulfur	NA	NA	NA	NA	6580J	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	2.0UJ	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	5.0U	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	81.4J	NA	NA	NA	NA
Volatile Organics (ug/l)									
Acetone	10U	10U	10U	10U	11U	11U	11U	370	10U
Carbon Tetrachloride	5U	5U	5U	5U	5U	10U	10U		
1,1-Dichloroethane	5U	5U	5U	5U	5U	3J	3J	20U	5U
1,2-Dichloropropane	5U	5U	5U	5U	5U	10U	10U	24	5U
Tetrachloroethene	5U	5U	5U	5U	35	54	85	5J	5U
Toluene	1J	5U	5U	5U	5U	10U	10U	20U	5U
1,1,1-Trichloroethane	5U	5U	5U	5U	9	33	35	20U	5U
Trichloroethene	5U	5U	5U	5U	17	65	85	20U	5U

NA = Not Analyzed

Table 6. RFI Surface Sediment Analytical Data.

Sample Number	SD-01	SD-02	SD-02	SD-03	SD-04	SD-05	EQUIP
			DUPLICATE				BLANK
Inorganics (mg/kg)							
Aluminum	3830*	8,780*	8080*	1,210*	1,910*	7900*	22.30B*
Antimony	9.1BN	11.7UN	12.20UN	7.70UN	8.50BN	8.90UN	6.60UN
Arsenic	3.6	3.6	3.10B	2.90	2.90	4.40	1.40U
Barium	37.2B	70.5B	64.80B	12.20B	15.00B	63.70	2.00U
Beryllium	1.2B	0.82B	0.74B	1.80	1.50	0.70B	0.20U
Calcium	97,600E	31,400E	29,000E	128,000E	180,000E	23,000E	100UE
Chromium	2.2B	12.9	11.60	1.20U	1.20U	12.2	1.0U
Cobalt	4.1B	6.2B	5.00B	3.10B	3.50B	5.60B	1.0U
Copper	11.4	32.9	23.70	6.70	9.20	29.20	1.4U
Cyanide (amenable)	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cyanide (total)	0.59U	0.89U	0.92U	0.59U	0.58U	0.67U	0.50U
Iron	7,170*	13,400*	11,800*	5,040*	5,000*	16,200*	54.40*
Lead	12.4	40.7	30.30	4.20B	5.90W	72.40W	0.44B
Magnesium	35,400	10,900	9,440	46,900	51,500	8,730	55.80U
Manganese	308*	400*	318*	306*	299*	368*	0.26B*
Mercury	0.12U	0.18U	0.31	0.12U	0.12U	0.13U	0.10U
Nickel	8.2B	14.7	12.60B	4.80B	5.50B	14.30	1.40U
Potassium	455B	1,020B	957B	220B	276B	802B	52.80U
Selenium	0.71UN	1.10UN	1.10UNW	0.70UN	0.70UN	0.81UN	0.60U
Thallium	0.48UW	0.71UW	0.71UW	0.47UW	0.47UW	0.54UW	0.40U
Vanadium	9.9B	20.7	18.20B	6.80B	6.70B	20.7	1.40U
Zinc	36*	134*	173*	20.4*	27.20*	119*	0.80B*
Volatile Organics (ug/kg)							
Acetone	12U	33B	28B	12U	12U	13U	10U
Methylene Chloride	25	42	28	6U	6U	36	5U
Tetrachloroethene	5J	80	4J	6U	6U	5J	5U

NA = Not Analyzed

DATA QUALIFIER KEY

Shaded concentrations exceed the ARARs.

Inorganic Qualifiers:

- U Chemical not detected at specified detection limit
- J Estimated value
- * Duplicate analysis was not within control limits
- B Reported value is Below Contract Required Detection Limit (DL) but above Instrument DL
- N Spiked sample recovery not within control limits
- W Post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is <50% of spike absorbance
- E Value is estimated due to matrix interferences
- M Duplicate injection precision criteria not met
- S Reported value was determined by the Method of Standard Additions (MSA)

Organic Qualifiers:

- U Chemical not detected at specified detection limit
- J Estimated value
- B Analyte was found in associated blank as well as sample (for volatiles only)
- E Concentrations exceeds calibration range of GC/MS instrument
- D Chemical identified in an analysis at a secondary dilution factor

Table 7. RFI Ground Water Field Chemistry Data.

Sample	Date	pH (Std. Units)	T (deg C)	SpC 25 (umhos/cm)
MW-3	03/02/92	6.7	17.0	838
MW-9	03/03/92	7.2	17.5	852
MW-20	03/03/92	7	18.2	782
MW-12	03/02/92	6.9	19.0	802
	07/27/92	7.0	21.0	758
	02/16/93	7.2	4.0	751
MW-21	03/03/92	7.1	18.9	690
MW-21Dup	03/03/92	7.1	18.5	719
MW-22	03/02/92	7.1	18.5	856
	07/27/92	6.9	21.0	758
	02/16/93	7.2	3.0	621
MW-24	03/02/92	7.1	19.0	881
	02/16/93	7.2	3.0	759
MW-26	03/03/92	7.1	17.6	908
MW-27	02/17/93	7.3	0.0	880
MW-28	02/17/93	7.4	0.0	787
MW-29	02/17/93	7.5	0.0	919
MW-30	02/17/93	7.3	0.0	938
IT-2	03/04/92	7.1	16.0	869
	07/27/92	7.0	18.5	822
	02/16/93	7.2	6.0	785
IT-3	03/03/92	6.5	1.05	853
	07/27/92	7.0	2.00	74
	02/16/93	7.1	4.0	776
IT-3Dup	02/16/93	7.2	3.0	793
MW-23	03/03/92	7.5	17.0	531
MW-23Dup	03/03/92	7.6	17.0	555
MW-23	02/17/93	7.9	0.0	614
MW-23Dup	02/17/93	7.8	0.0	632
MW-25	03/10/92	7.3	11.0	614
	02/17/93	7.8	2.0	580
IT-1A	03/03/92	7.3	18.1	495
	02/17/93	8.0	0.0	612

Table 7, Continued.

Sample (depth)	Date	pH (Std. Units)	T (deg C)	SpC 25 (umhos/cm)
PGP-1	02/16/93	7.4	4.0	684
PGP-2	02/16/93	7.4	9.0	662
PGP-3	02/18/93	6.9	10.5	600
PGP-4S	02/17/93	7.5	0.0	938
PGP-4D	02/17/93	7.7	0.0	882
PGP-6 (18-20)	02/25/93	7.2	7.0	930
PGP-6 (25-27)	02/25/93	7.3	6.01	1020
PGP-7 (13-15)	02/25/93	7.2	5.0	1052
PGP-7 (19-21)d	02/25/93	7.3	3.0	845
PGP-7 (19-21)	02/25/93	7.3	6.0	801
PGP-7 (24.5-26.5)	02/25/93	7.4	6.0	816
PGP-8	02/26/93	7.4	8.0	740
PGP-9	02/26/93	7.4	8.0	800
PGP-10	03/02/93	6.7	9.0	720

REVISED TABLE 8

REPLACE^P_N EXISTING TABLE

Table 8. Ground Water Analytical Data.

Sample Number Date Sampled	MW-9	MW-20	MW-26	IT-2	IT-2	IT-2	IT-3	IT-3	IT-3
	03/03/92	03/03/92	03/03/92	03/03/92	07/27/92	02/16/93	03/03/92	07/27/92	02/16/93
Inorganics (mg/l)									
Aluminum	5.510	5.71	5.02	5.020	14.2NJ	0.991NJ	11	16.0NJ	5.2NJ
Antimony	0.017UN	0.017UN	0.017U	0.017U	0.039UN	0.016UN	0.017UN	0.039UN	0.016UN
Arsenic	0.006UN	0.006UN	0.006U	0.006UN	0.0062B	0.0024BNJ	0.006UNWM	0.011B	0.0039BJ
Barium	0.27	0.38	0.223	0.694	0.815	0.258	0.423	0.409	0.201
Beryllium	0.0014B	0.0011B	0.001U	0.0011B	0.0051J	0.001U	0.0018B	0.0065J	0.001U
Cadmium	0.002U	0.002U	0.002U	0.002U	0.003U	0.003U	0.002U	0.003U	0.003U
Calcium	525	612	345	394	523	123	567	480	226
Chromium	0.027	0.0201	0.0232	0.0169	0.0244	0.008BJ	0.0328	0.0339	0.0132J
Cobalt	0.0156B	0.0125B	0.011B	0.0153B	0.0252B	0.008UJ	0.0344B	0.0428B	0.0062BJ
Copper	0.0727	0.0674	0.0474	0.0767	0.0871	0.0075BJ	0.0949	0.0724	0.0234BJ
Cyanide (amenable)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cyanide (total)	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U
Iron	15.7	13.2	15.9	21.2	37.5J*	2.50J	28.4	43.9J*	8.25J
Lead	0.0585*	0.0408*	0.03243*	0.04175*	0.051NJ3	0.0025BNJ	0.079*	0.0504JNW	0.0119JN
Magnesium	158	232	114	123	180	41	187	151	67
Manganese	1.03	2.44	1.02	1.73	2.25J	0.362J	2.8	3.96J	0.936J
Mercury	0.00038	0.00034	0.00023	0.0002	0.0002U	0.0002U	0.0003	0.00053	0.0002U
Nickel	0.0476	0.0409	0.0324	0.0501	0.135	0.0194BJ	0.0646	0.0813	0.0248BJB
Potassium	3.84B	4.59B	7.01	3.610B	4.8B	1.68B	3.51B	4.13B	2.37B
Selenium	0.043B	0.003U	0.003UW	0.003U	0.002UJWN	0.001U	0.0053	0.002UJN	0.0016BUNW
Silver	0.002U	0.002U	0.002U	0.002U	0.008U	0.002U	0.002U	0.008U	0.002U
Sodium	9.53	10.3	10	20.9	19.8J	18.8J	7.39	7.28J	7.49J
Thallium	0.002UN	0.002UN	0.002UN	0.002U	0.002U	0.003U	0.002UN	0.002U	0.003U
Vanadium	0.0421B	0.0354B	0.0227B	0.023B	0.0372B	0.006U	0.0369B	0.0379B	0.0104BJ
Zinc	0.198E	1.06E	0.0899E	0.110E	0.197J	0.153BJE	0.177E	0.171J	0.0494
Volatile Organics (ug/l)									
Acetone	7J	10U	10U	11	12U	10U	5U	12U	10U
Carbon Tetrachloride	5U	5U	5U	5U	5U	10U	5U	5U	10U
1,1-Dichloroethane	5U	5U	5U	41	17	18	4J	4J	5J
1,1-Dichloroethylene	5U	5U	5U	5U	5U	10U	5U	5U	11
1,2-Dichloroethene (total)	5U	5U	5U	76	30	51	5U	5U	10U
1,2-Dichloropropane	5U	5U	5U	5U	5U	10U	5U	5U	10U
Ethylbenzene	5U	5U	5U	5U	5U	10U	5U	5U	10U
Methylene Chloride	5U	5U	5U	5U	1J	10U	5U	5U	10U
Tetrachloroethene	5U	5U	5J	5U	10U	5J	5U	5	10U
Toluene	5U	5U	5U	5U	5U	10U	5U	5U	10U
1,1,1-Trichloroethane	9	5U	5	25	28	29	83	67	71
Trichloroethene	2J	5U	5U	13	29	29	24	22	29
Xylenes	5U	5U	5U	5U	5U	10U	5U	5U	10U

NA = Not Analyzed

Table 8, Continued.

Sample Number Date Sampled	IT-3	MW-3	MW-12	MW-12	MW-12	MW-12	MW-12	MW-21
	02/16/93	03/02/92	03/02/92	03/02/92	07/27/92	02/16/93	02/16/93	03/03/92
	Duplicate		Dissolved	Total		Dissolved		
Inorganics (mg/l)								
Aluminum	5.43NJ	4.88	NA	NA	8.35NJ	0.129BNJ	3.51NJ	8.5
Antimony	0.016UN	0.017U	<0.06	<0.06	39.0UN	0.016UN	0.016UN	0.017UN
Arsenic	0.007BNJ	0.0033B	<0.010	<0.010	7.0B	0.002UNJ	0.0031BNJ	0.006UN
Barium	0.218	0.269	0.101	0.559	296	0.796B	0.159B	0.472
Beryllium	0.001U	0.001U	<0.005	<0.005	5.1J	0.001U	0.001U	0.0026B
Cadmium	0.003U	0.002U	<0.005	<0.005	3.0U	0.003U	0.003U	0.0025B
Calcium	263	340	NA	NA	401	90.2	193	1,000
Chromium	0.0181J	0.0156	<0.005	0.0247	12.7	0.006UJ	0.0116J	0.0585
Cobalt	0.0151BJ	0.003B	<0.010	0.0504	20.6B	0.006UJ	0.0053BJ	0.075
Copper	0.0321	0.0906	<0.010	0.160	53.3	0.0022BJ	0.0238BJ	0.51
Cyanide (amenable)	<0.010	<0.010	<0.010	<0.010	<0.010	NA	<0.010	<0.010
Cyanide (total)	0.010U	0.010U	NA	NA	0.010U	NA	0.010U	0.010U
Iron	15.1J	8.79	NA	NA	34.2*J	0.0343BU	12.9J	7.67
Lead	0.0196NJ	0.0295S	0.00908	0.6234	0.0543BNJ	0.002UNJ	0.0223NJ	0.152*
Magnesium	90.8	65.7	NA	NA	114	27	45	342
Manganese	1.72	0.932	NA	NA	2.12J	0.131J	0.762J	2.62
Mercury	0.002UN	0.00026	<0.0002	0.00048	0.00026	0.0002UN	0.0002UN	0.00035
Nickel	0.0357BJ	0.0588	<0.010	0.118	0.052	0.015UJ	0.0394BJ	0.538
Potassium	2.51BU	3.54B	NA	NA	3.74B	1.59BU	2.490BU	3.57B
Selenium	0.0015BWNJ	0.0034B	<0.005	0.0075	0.0029BWNJ	0.001UN	0.0021BWNJ	0.0075
Silver	0.002U	0.0121	<0.010	<0.010	0.008U	0.002U	0.002U	0.0467
Sodium	7.49J	8.79	NA	NA	9.13J	8.35J	8.25J	6.53
Thallium	0.003U	0.002U	<0.010	<0.010	0.002UWN	0.003UW	0.003UW	0.002UN
Vanadium	0.0174BJ	0.024B	<0.010	0.0289	0.0267B	0.006U	0.0096BJ	0.0638
Zinc	0.0769EJ	0.0944E	0.0119	0.345	0.165J	0.0034BEU	0.0696EJ	0.256E
Volatile Organics (ug/l)								
Acetone	10U	10U	NA	<500	500U	NA	1000U	10U
Carbon Tetrachloride	10U	5U	NA	<250	250U	NA	1000U	5U
1,1-Dichloroethane	5J	5U	NA	103J	190J	NA	136J	5U
1,1-Dichloroethylene	1J	5U	NA	<250	250U	NA	1000U	5U
1,2-Dichloroethene (total)	10U	5U	NA	NA	250U	NA	1000U	5U
1,2-Dichloropropane	10U	5U	NA	<250	250U	NA	1000U	5U
Ethylbenzene	10U	5U	NA	<250	250U	NA	1000U	5U
Methylene Chloride	10U	5U	NA	<250	250U	NA	1000U	5U
Tetrachloroethene	10U	160	NA	3471	5900	NA	5685	59
Toluene	10U	5U	NA	<250	250U	NA	1000U	5U
1,1,1-Trichloroethane	73	4J	NA	2041	5400	NA	2221	5U
Trichloroethene	23	81	NA	2641	4700	NA	4759	15
Xylenes	10U	5U	NA	<250	250U	NA	1000U	5

NA = Not Analyzed

Table 8, Continued.

Sample Number Date Sampled	MW-21	MW-22	MW-22	MW-22	MW-22	MW-22	MW-24	MW-24
	03/03/92	03/02/92	03/02/92	07/27/92	02/16/93	02/16/93	03/02/92	02/16/93
	Duplicate	Dissolved	Total		Dissolved			
Inorganics (mg/l)								
Aluminum	0.101B	NA	NA	7.55NJ	0.0744BNJ	5.15NJ	15.5	10.6NJ
Antimony	0.017UN	<0.06	<0.06	0.039UN	0.016UN	0.016UNJ	0.017U	0.016UN
Arsenic	0.006UN	<0.010	<0.010	0.0025B	0.002UNJ	0.002UN	0.0044B	0.0035BNJ
Barium	0.528	0.0824	0.307	0.216	0.0655B	0.165B	0.505	0.266
Beryllium	0.001U	<0.005	<0.005	0.0055J	0.001U	0.001U	0.0023B	0.001U
Cadmium	0.002U	<0.005	<0.005	0.003U	0.003U	0.003U	0.002U	0.003U
Calcium	1170	NA	NA	387	82.2	275	774	390
Chromium	0.0873	<0.005	0.0365	0.0182	0.006UJ	0.0178J	0.0371	0.0303J
Cobalt	0.011B	<0.010	0.0343	0.0157B	0.006UJ	0.0135J	0.0231B	0.0228BJ
Copper	0.0181B	<0.010	0.234	0.0945	0.002U	0.0962J	0.142	0.0789J
Cyanide (amenable)	<0.010	<0.010	NA	<0.010	NA	<0.010	<0.010	<0.010
Cyanide (total)	0.010U	NA	NA	0.010U	NA	0.010U	0.010U	0.010U
Iron	0.407	NA	NA	11.97J	0.0245BU	12.6J	15.1	20.1J
Lead	0.0046*	<0.003	0.06342	0.0331WNJ	0.002UNJ	0.0292NJ	0.0894W	0.07645NSJ
Magnesium	323	NA	NA	128	25.4	97.6	178	125
Manganese	2.440	NA	NA	2.1J	0.387J	1.56J	2.17	2.01J
Mercury	0.00045	<0.0002	0.00026	0.00039	0.0002UN	0.0002UN	0.00067	0.0002UN
Nickel	0.122	<0.010	0.0929	0.0546	0.015UJ	0.0453J	0.0652	0.0586J
Potassium	3.52B	NA	NA	3.66B	1.59BU	2.53BU	5.53	3.050BU
Selenium	0.259SM	<0.005	<0.005	0.002UWN	0.0019BWNJ	0.002BWNJ	0.0049BS	0.0022BWNJ
Silver	0.002U	<0.010	0.0622	0.0233	0.002U	0.0147	0.002U	0.002U
Sodium	7.53	NA	NA	8.82J	5.47J	5.48J	5.84	5.16J
Thallium	0.002UN	<0.01	<0.010	0.002UWN	0.003U	0.003UW	0.002U	0.003U
Vanadium	0.089	<0.010	0.0705	0.0282B	0.006U	0.026BJ	0.0538	0.0346BJ
Zinc	0.0053BE	<0.010	0.236	0.109J	0.0032BEU	0.106EJ	0.224E	0.164EJ
Volatile Organics (ug/l)								
Acetone	10U	NA	<1,000	2000U	NA	1000U	10U	5J
Carbon Tetrachloride	5U	NA	<500	1000U	NA	1000U	5U	10U
1,1-Dichloroethane	5U	NA	<500	1000U	NA	1000U	5U	10U
1,1-Dichloroethylene	5U	NA	<500	1000U	NA	1000U	5U	10U
1,2-Dichloroethene (total)	5U	NA	NA	1000U	NA	1000U	5U	10U
1,2-Dichloropropane	5U	NA	<500	1000U	NA	1000U	5U	10U
Ethylbenzene	5U	NA	<500	1000U	NA	1000U	5U	10U
Methylene Chloride	5U	NA	<500	1000U	NA	1000U	2J	10U
Tetrachloroethene	58	NA	16,774	21000	NA	19499	8	10U
Toluene	5	NA	<500	1000U	NA	1000U	1J	10U
1,1,1-Trichloroethane	0.8J	NA	<500	1000U	NA	1000U	44	53
Trichloroethene	14	NA	3,187	2500	NA	1956J	40	189
Xylenes	5U	NA	<500	1000U	NA	1000U	5U	10U

NA = Not Analyzed

Table 8, Continued.

Sample Number Date Sampled	MW-27	MW-28	MW-29	MW-30	IT-1A	IT-1A	MW-23	MW-23Dup
	02/17/93	02/17/93	02/17/93	02/17/93	03/03/92	02/17/93	03/03/92	03/03/92
Inorganics (mg/l)								
Aluminum	13.5J	3.99U	11.2J	8.31J	0.484	0.327J	15.3	14.7
Antimony	0.035UN	0.035UN	0.035UN	0.035UN	0.017UN	0.035UN	0.017UN	0.017UN
Arsenic	0.0058BNJ	0.0058BNJ	0.0058BNJ	0.0152UN	0.077N	0.0406JUN	0.0075BN	0.0074BN
Barium	0.509	0.127B	0.701	0.569	0.144B	0.120B	0.5	0.473
Beryllium	0.0019B	0.001U	0.001B	0.001U	0.001U	0.001U	0.0021B	0.0019B
Cadmium	0.002UB	0.002U	0.002U	0.002U	0.002U	0.0054	0.002U	0.002U
Calcium	998	202	1100	936	63	66.3	193	169
Chromium	0.0354J	0.0197J	0.0229J	0.0221J	0.004U	0.0083JB	0.0284	0.0256
Cobalt	0.0226BJ	0.0148BJ	0.041BJ	0.0229BJ	0.004U	0.005UJ	0.0136B	0.0116B
Copper	0.233	0.0803	0.0827	0.0629	0.006U	0.0148UB	0.13	0.121
Cyanide (amenable)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cyanide (total)	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U
Iron	26	12.7J	30.5J	24.5J	2.92	7.01J	26	23.1
Lead	0.112	0.0416	0.109	0.0374	0.0027B*	0.0063U	0.0693*	0.0957*
Magnesium	172	67.4	181	98.7	30.8	30.4	73.3	63.2
Manganese	2.27J	0.803J	4.0J	4.44J	0.202	0.333J	3.26	2.9
Mercury	0.0002UN	0.0002UN	0.00057NJ	0.0002UN	0.0002U	0.00033N	0.0002U	0.0002U
Nickel	0.123J	0.040J	0.0953J	0.0774J	0.0113B	0.018UJ	0.0417	0.0346B
Potassium	3.8BJ	2.36BJ	5.47J	4.13BJ	1.83B	2.13BJ	2.87B	2.88B
Selenium	0.0068B	0.001UW	0.003U	0.005U	0.003U	0.001U	0.003U	0.003U
Silver	0.0084B	0.003U	0.003U	0.003U	0.002U	0.003U	0.002U	0.002U
Sodium	5.81E	5.44E	7.84E	6.5E	34.8	29.3E	31.2	30.9
Thallium	0.002UW	0.002U	0.002UW	0.002UW	0.002UN	0.002U	0.002UN	0.002UN
Vanadium	0.0369BJ	0.0211BJ	0.036BJ	0.0238BJ	0.004U	0.004UJ	0.037B	0.0367B
Zinc	0.296J	0.0862J	0.458J	0.151J	0.0092BE	0.0239J	0.261E	0.234E
Volatile Organics (ug/l)								
Acetone	120U	50U	18U	27U	8J	10U	10U	10U
Carbon Tetrachloride	50U	52	10U	20U	5U	10U	5U	5U
1,1-Dichloroethane	50U	50U	2J	59	5U	10U	5U	5U
1,1-Dichloroethylene	50U	5J	10U	5J	5U	10U	5U	5U
1,2-Dichloroethene (total)	50U	50U	10U	20U	5U	10U	5U	5U
1,2-Dichloropropane	50U	50U	10U	20U	5U	10U	5U	5U
Ethylbenzene	50U	50U	10U	20U	5U	10U	5U	5U
Methylene Chloride	50U	50U	10U	20U	5U	10U	5U	5U
Tetrachloroethene	537	318	93	20U	9	10U	47	40
Toluene	50U	50U	10U	20U	5U	10U	5U	5U
1,1,1-Trichloroethane	24J	415	16	311	5U	10U	5U	5U
Trichloroethene	50U	230	14	295	5U	10U	7	5
Xylenes	50U	50U	10U	20U	5U	10U	5U	5U

NA = Not Analyzed

Table 8, Continued.

Sample Number Date Sampled	MW-23	MW-23Dup	MW-25	MW-25	PGP-1	PGP-2	PGP-3	PGP-3
	02/17/93	02/17/93	03/10/92	02/17/93	02/16/93	02/16/93	02/18/93	02/18/93
								Duplicate
Inorganics (mg/l)								
Aluminum	12.7J	7.14J	0.7	6.73	0.649NJ	2.91NJ	0.432U	0.168B
Antimony	0.035UN	0.035UN	0.016U	0.035UN	0.016UN	0.016UN	0.035UN	0.035UN
Arsenic	0.0135NJ	0.01695NSJ	0.006U	0.0042BN	0.002UNJ	0.0046BNJ	0.002UNJ	0.002UN
Barium	0.442	0.456	0.00642B	0.162B	0.0499B	0.147B	0.096B	0.0942B
Beryllium	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U
Cadmium	0.002U	0.002U	0.002U	0.002U	0.003U	0.003U	0.002U	0.002U
Calcium	153	164	60	181	148	303	142	128
Chromium	0.0133J	0.0072JB	0.003U	.0163	0.006UJ	0.020J	0.004U	0.004U
Cobalt	0.0105BJ	0.0044BJB	0.006U	0.012B	0.006UJ	0.0073BJ	0.005UJ	0.005U
Copper	0.0821	0.0677	0.004U	0.0412	0.009BJ	0.037J	0.0078BU	0.003U
Cyanide (amenable)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cyanide (total)	0.010U	0.010U	0.010U	0.014U	0.010U	0.010U	0.010U	0.010U
Iron	22.4J	21.8J	1.82	19	1.1J	11.9J	1.45J	0.633
Lead	0.0353	0.0294W	0.0043W	0.249	0.0032NJ	0.0183NJ	0.0012BU	0.001U
Magnesium	58.9	65.8	26.6	62.5	46.5	81.6	44.2	38.8
Manganese	3.34J	3.15J	0.367	2.07	0.130J	0.802J	0.124J	0.0549
Mercury	0.00054NJ	0.0002U	0.0002U	0.0002U	0.0002UN	0.0002UN	0.0002UN	0.0002UN
Nickel	0.0402J	0.0261JB	0.003U	0.0481	0.0822J	0.683J	0.018UJ	0.018U
Potassium	2.76BJ	2.4BJB	2.25B	2.64B	0.892BU	2.82BU	3.22BJ	2.77B
Selenium	0.001UW	0.001UW	0.002U	0.001U	0.001BNU	0.001UWN	0.001U	0.001U
Silver	0.003U	0.003U	0.001U	0.003U	0.002U	0.002U	0.003U	0.003U
Sodium	29.3E	28.4E	25.7	28	15.1J	17.9J	6.26E	5.99E
Thallium	0.002U	0.002U	0.002U	0.002U	0.003UW	0.003UW	0.002UW	0.002UW
Vanadium	0.0255BJ	0.0207BJU	0.006U	0.0164B	0.006U	0.0144BJ	0.004UJ	0.004U
Zinc	0.107J	.0892J	0.0172B	0.103	0.0565EJ	0.614EJ	0.0566J	0.0234
Volatile Organics (ug/l)								
Acetone	10U	10U	10U	10U	7J	9J	10U	10U
Carbon Tetrachloride	10U	10U	5U	10U	10U	10U	10U	10U
1,1-Dichloroethane	10U	10U	5U	10U	10U	10U	2J	1J
1,1-Dichloroethylene	10U	10U	5U	10U	10U	10U	10U	10U
1,2-Dichloroethene (total)	10U	10U	5U	10U	10U	10U	2J	2J
1,2-Dichloropropane	10U	10U	5U	10U	10U	10U	10U	10U
Ethylbenzene	10U	10U	5U	10U	10U	10U	10U	10U
Methylene Chloride	10U	10U	5U	10U	10U	10U	10U	10U
Tetrachloroethene	31U	38U	2J	19	10U	10U	10U	10U
Toluene	10U	10U	5U	10U	10U	10U	10U	10U
1,1,1-Trichloroethane	2J	2J	5U	10U	10U	10U	1J	1J
Trichloroethene	13J	21J	5U	11	10U	10U	10U	10U
Xylenes	10U	10U	5U	10U	10U	10U	10U	10U

NA = Not Analyzed

Table 8, Continued.

Sample Number Date Sampled	PGP-4S	PGP-4D	PGP-6	PGP-6	PGP-6	PGP-7	PGP-7	PGP-7Dup	PGP-7
	02/17/93	02/17/93	02/24/93	02/24/93	02/24/93	02/24/93	02/24/93	02/24/93	02/24/93
			13.0-15.0	18.0-20.0	25-27	13-15	19-21	19-21	24.5-26.5
Inorganics (mg/l)									
Aluminum	0.046J	0.014J	3.54*J	3.17*J	3.6*J	3.64*J	2.02*J	1.75*J	0.48*UJ
Antimony	0.035UN	0.035UN	0.024UN	0.024UN	0.024UN	0.024UN	0.024UN	0.024UN	0.024UN
Arsenic	0.0025BNJ	0.0047BNJ	0.0036BWNJ	0.0038BWNJ	0.0037BNJ	0.0036BNJ	0.004BWNJ	0.0028BNJ	0.002UNJ
Barium	0.0942B	0.117B	0.176B	0.124B	0.174B	0.142B	0.131B	0.128B	0.110B
Beryllium	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U
Cadmium	0.002U	0.002U	0.002B	0.002U	0.0023B	0.002U	0.002U	0.002U	0.002U
Calcium	153	232	546	380	292	381	232	230	159
Chromium	0.004U	0.0054BJ	0.0186UJ	0.0114UJ	0.0283J	0.0462J	0.0133UJ	0.0076BUJ	0.0057BUJ
Cobalt	0.0062BJ	0.0055BJ	0.0218B	0.0105B	0.0127B	0.0258B	0.0212B	0.0183B	0.005U
Copper	0.0164B	0.0107BU	0.0284J	0.0219B	0.0309J	0.0326J	0.0189BU	0.0174BU	0.0073BU
Cyanide (amenable)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cyanide (total)	0.010U	0.010U	0.010UN	0.010UN	0.010UN	0.010UN	0.010UN	0.010UN	0.010UN
Iron	4.33J	4.66J	12.1*J	11.9*J	16.1*J	15.4*J	12*J	9.96*J	2.36*UJ
Lead	0.0061	0.0045U	0.0186	0.0194	0.02735	0.0334	0.0329	0.0244	0.0037
Magnesium	44.1	40.7	135	134	96.2	129	80.7	73.6	49.2
Manganese	0.394J	0.606J	1.66	0.825	0.671	1.58	1.04	0.933	0.224
Mercury	0.00033N	0.0002UN	0.0002U	0.0002U	0.0002U	0.0002U	0.0002U	0.0002U	0.0002U
Nickel	0.0653J	0.400J	0.206J	0.0935J	0.153J	0.160J	0.0392JB	0.03BJ	0.027UJ
Potassium	3.09BJ	3.82BJ	6.94J	3.4JB	7.81J	3.46BJ	2.34JB	2.13JB	3.66BJ
Selenium	0.001U	0.001UW	0.0012BWNJ	0.001UWNJ	0.0015BNJ	0.001UWN	0.0016BUJ	0.001UNJ	0.001UNJ
Silver	0.003U	0.003U	0.003U	0.003U	0.003U	0.003U	0.003U	0.003UB	0.003U
Sodium	8.0E	9.29E	16.1	11.2J	9.92J	6.45J	8.79J	8.97J	10.6J
Thallium	0.002UW	0.002UW	0.002UWN	0.002UWN	0.002UWN	0.002UWN	0.002UWN	0.002UWN	0.002UN
Vanadium	0.004UJ	0.004UJ	0.0174BUJ	0.0187BUJ	0.0212BJ	0.0182BUJ	0.0163BJ	0.0122BUJ	0.004UJ
Zinc	0.173J	0.289J	0.469J*	0.166*J	0.305*J	0.224*J	0.0835*UJ	0.067*J	0.0351*UJ
Volatile Organics (ug/l)									
Acetone	500U	1051U	15U	12U	10U	16U	13U	13U	10U
Carbon Tetrachloride	500U	1000U	10U	10U	10U	10U	10U	10U	10U
1,1-Dichloroethane	138J	817J	10U	10U	2J	10U	10U	10U	10U
1,1-Dichloroethylene	500U	1000U	10U	10U	10U	10U	10U	10U	10U
1,2-Dichloroethene (total)	500U	1000U	10U	2J	42	10U	10U	10U	10U
1,2-Dichloropropane	500U	1000U	10U	10U	10U	10U	10U	10U	10U
Ethylbenzene	500U	1000U	10U	10U	10U	10U	10U	10U	10U
Methylene Chloride	500U	1000U	10U	10U	10U	10U	10U	10U	10U
Tetrachloroethene	500U	8749	10U	10U	10U	10U	10U	10U	10U
Toluene	500U	1000U	3J	4J	10U	10U	10U	10U	10U
1,1,1-Trichloroethane	1722	1159	10U	2J	11	2J	14	14	10U
Trichloroethene	5957	4244	10U	10U	3J	1J	14	14	10U
Xylenes	500U	1000U	1J	2J	10U	10U	10U	10U	10U

NA = Not Analyzed

Table 8, Continued.

Sample Number Date Sampled	PGP-12	PGP-13	PGP-13	PGP-14	PGP-15	PGP-16	PGP-16	PGP-18
	05/21/93	05/21/93	05/21/93	05/21/93	04/29/94	04/29/94	04/29/94	04/29/94
			Duplicate				Duplicate	
Inorganics (mg/l)								
Aluminum	2.65J	0.330U	0.595	2.75J	23.6	2.56J	0.490UJ	12.7
Antimony	0.023U	0.023U	0.023U	0.023U	0.053U	0.053U	0.053U	0.053U
Arsenic	0.0061B	0.002U	0.002U	0.0036B	0.0054B	0.0041B	0.002U	0.0065B
Barium	0.918	0.0792B	0.0679B	0.125B	0.430	0.120J	0.0787	0.187B
Beryllium	0.001U	0.001U	0.001U	0.001U	0.0012B	0.001U	0.001U	0.001B
Cadmium	0.003U	0.003U	0.003U	0.003U	0.004U	0.004U	0.004U	0.004U
Calcium	493	197	149	213	871	239J	139J	446
Chromium	0.0237U	0.0072U	0.0067U	0.0285U	0.110	0.0082B	0.006U	0.0472
Cobalt	0.0076B	0.0095B	0.006U	0.006U	0.004	0.009U	0.009U	0.042B
Copper	0.0312	0.0097B	0.0104B	0.0351	0.114	0.023UJ	0.0136UJ	0.137
Cyanide (amenable)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cyanide (total)	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U
Iron	15.8	2.85U	2.35U	8.71	23.5	10.4J	2.0J	61.8
Lead	0.0198	0.0027U	0.0035U	0.0163	0.0616	0.0071UJ	0.0025UJ	0.044
Magnesium	64.9	26.1	44.4	74.4	312	75.5	39.3J	157
Manganese	1.74	0.754	0.180U	1.08	5.71	0.842J	0.150J	3.33
Mercury	0.0002U	0.0002U	0.0002U	0.0002U	0.00026	0.0002U	0.0002U	0.00022
Nickel	0.0314B	0.0209B	0.007U	0.0375B	0.162	0.0146B	0.012U	0.124
Potassium	6.02	1.54B	2.06B	1.42B	5.73	2.83B	2.35B	3.58B
Selenium	0.002U	0.002U	0.002U	0.002U	0.002U	0.0028B	0.0034B	0.002U
Silver	0.007U	0.007U	0.007U	0.007U	0.006U	0.006U	0.006U	0.006U
Sodium	15.2	16.8U	27.9	17.8U	30.7	23.5J	23.5J	11.8
Thallium	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.002U	0.0025B
Vanadium	0.0084B	0.005U	0.005U	0.0068B	0.0596	0.0114B	0.008U	0.0412B
Zinc	0.180U	0.377	0.063U	0.181U	0.891	0.0397UJ	0.0145UJ	0.359
Volatile Organics (ug/l)								
Acetone	10U	7J	10U	10U	10U	25U	25U	10U
Carbon Tetrachloride	10U	10U	10U	10U	5U	12U	12U	5U
1,1-Dichloroethane	10U	10U	10U	10U	5U	12U	12U	5U
1,1-Dichloroethylene	10U	10U	10U	10U	5U	12U	12U	5U
1,2-Dichloroethene (total)	10U	10U	10U	10U	5U	12U	12U	5U
1,2-Dichloropropane	10U	10U	10U	10U	5U	12U	12U	5U
Ethylbenzene	10U	10U	10U	10U	5U	12U	12U	5U
Methylene Chloride	10U	10U	10U	10U	6U	22UJ	22UJ	12U
Tetrachloroethene	10U	10U	10U	10U	79	12U	12U	5U
Toluene	10U	10U	10U	10U	5U	12U	12U	5U
1,1,1-Trichloroethane	10U	10	11	10U	37	100	98	51
Trichloroethene	10U	22	25	10U	75	400J	380	170
Xylenes	10U	10U	10U	10U	5U	12U	12U	5U

NA = Not Analyzed

DATA QUALIFIER KEY

Shaded concentrations exceed the ARARs.

Inorganic Qualifiers:

- U Chemical not detected at specified detection limit
- J Estimated value
- * Duplicate analysis was not within control limits
- B Reported value is Below Contract Required Detection Limit (DL) but above Instrument DL
- N Spiked sample recovery not within control limits
- W Post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is <50% of spike absorbance
- E Value is estimated due to matrix interferences
- M Duplicate injection precision criteria not met
- S Reported value was determined by the Method of Standard Additions (MSA)

Organic Qualifiers:

- U Chemical not detected at specified detection limit
- J Estimated value
- B Analyte was found in associated blank as well as sample (for volatiles only)
- E Concentrations exceeds calibration range of GC/MS instrument
- D Chemical identified in an analysis at a secondary dilution factor

Table 9. Summary of Redevelopment Activities, Unit D Monitoring Wells.

Well No.	Date	Elapsed Time (min.)	Flow Rate (GPM)	Volume (gal.)	Total Volume
MW-23	29 July 92	31	3.3	102	342
		60	4.0	240	
	07 Jan. 93	70	2.0	140	140
	16 Feb. 93	90	3.0	270	270
					752
MW-25	29 July 92	32	1.5	48	217
		16	1.7	27	
		71	2.0	142	
	07 Jan. 93	25	2.5	63	293
		115	2.0	230	
	16 Feb. 93	145	2.5	363	363
					873
IT-1A	29 July 92	36	0.7	25	67
		52	0.8	42	
	07 Jan. 93	70	0.8	56	56
	16 Feb. 93	180	0.8	144	144
					267

GPM=Gallons per Minute

Table 10. RFI Ground Water VOC Screening Analytical Results

	SGP-9	SGP-10	SGP-11	SGP-12	SGP-13	SGP-14
1,1-Dichloroethane	<1.0	<1.0	<1.0	4.7	8.0	<1.0
1,1,1-Trichloroethane	32.8	<1.0	44.2	57.2	99.3	3.7
Tetrachloroethene	53.7	<1.0	8.0	<1.0	<1.0	10.9
Trichloroethene	63.8	<1.0	133.9	319.2	397.7	13.6

	SGP-15	SGP-16	SGP-17	SGP-18	SGP-19	SGP-20
1,1-Dichloroethane	<1.0	18.0	14.3	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	25.8	195.6	103.4	21.2	<1.0	30.4
Tetrachloroethene	136.5	<1.0	5.5	<1.0	<1.0	<1.0
Trichloroethene	53.1	812.3	544.7	107.2	<1.0	271.4

	SGP-21	SGP-22	SGP-23	SGP-24	SGP-25	SGP-26
1,1-Dichloroethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	45.4	<1.0	<1.0	17.8	<1.0	35.1
Tetrachloroethene	20.4	<1.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene	43.5	<1.0	<1.0	113.7	<1.0	161.9

	SGP-27	SGP-28
1,1-Dichloroethane	<1.0	<1.0
1,1,1-Trichloroethane	<1.0	<1.0
Tetrachloroethene	<1.0	<1.0
Trichloroethene	<1.0	<1.0

All results reported in units of Parts Per Billion (PPB) (or ug/l).

Table 11
Ground Water and Soil ARARs
Former Amphenol Site, Franklin, IN
Units as Given

Chemical	Final Risk-Based PRG Concentrations for Soil (residential) (mg/kg)	Final Risk-Based PRG Concentrations for Ground Water (ug/L)	Maximum Contaminant Level (MCL) (mg/L)	Maximum Contaminant Level Goal (MCLG) (ug/L)	RCRA Subpart S Action Levels	
					Soil (mg/kg)	Ground Water (ug/L)
Acetone	27400	3650	#N/A	#N/A	8000	4000
2-Butanone	13700	1120	#N/A	#N/A	4000	2000
Carbon tetrachloride	4.91	0.259	5	Zero	5	MCL
Chloroform	105	0.275	#N/A	#N/A	100	6
1,1-Dichloroethane	27400	1010	#N/A	#N/A	7500(calc)	3500(calc)
1,1-Dichloroethylene	1.06	0.0678	7	7	10	MCL
1,2-Dichloroethene	2460	329	70(cis)	70(cis)	675(calc)	MCL
Methylene Chloride	85.2	11.4	5	Zero	90	MCL
4-Methyl-2-pentanone	13700	176	#N/A	#N/A	4000	2000
Tetrachloroethene	12.3	1.43	5	Zero	10	MCL
Toluene	54800	859	1000	1000	20000	MCL
1,1,1-Trichloroethane	24600	1550	200	200	7000	MCL
Trichloroethene	58.1	2.54	5	Zero	60	MCL
Xylene, total	548000	73000	10000	10000	200000	MCL
Aluminum	#N/A	#N/A	50(S)	#N/A	#N/A	#N/A
Antimony	110	14.6	6	6	30	MCL
Arsenic	0.355	0.0473	50	#N/A	80	MCL
Barium	19200	2560	2000	2000	4000	MCL
Beryllium	0.149	0.0198	4	4	0.2	MCL
Cadmium	137	18.3	5	5	40	MCL
Calcium	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Chromium, VI	1370	183	100(total)	100(total)	400	MCL
Cobalt	274	0.365	#N/A	#N/A	0.75(calc)	0.35(calc)
Copper	10200	1360	1300(A)	1300(A)	#N/A	MCL
Cyanide	5480	730	200(P)	200(P)	2000	4
Iron	#N/A	#N/A	300(S)	#N/A	#N/A	#N/A
Lead	#N/A	#N/A	15(A)	Zero	#N/A	MCL
Magnesium	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Manganese	1370	183	50(S)	#N/A	375(calc)	175(calc)
Mercury	82.1	11	2	2	20	MCL
Nickel	5480	730	100	100	2000	MCL
Potassium	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Selenium	1370	183	50	50	375(calc)	MCL
Silver	1370	183	100(S)	#N/A	200	50
Sodium	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Thallium	19.2	2.56	2	0.5	6	MCL
Tin	164000	21900	#N/A	#N/A	45000(calc)	21000(calc)
Vanadium	1920	256	#N/A	#N/A	525(calc)	245(calc)
Zinc	82100	11000	5000(S)	#N/A	22500(calc)	10500(calc)

#N/A = Not available

ARAR = Applicable or Relevant and Appropriate Requirements.

P=Proposed

S=Secondary standard

PRG = Preliminary Remediation Goal (health-based).

A=Action Level

MCLs and MCLGs are from "Drinking Water Regulations and Health Advisories", U.S. EPA, December 1992.

Calc = calculated according to the recommended assumptions given in the proposed Subpart S rules.

Table 12
Toxicity Values For Site Chemicals
Former Amphenol Site, Franklin, IN
Units as Given

Chemical	Chronic Oral Reference Dose (mg/kg day)	Source	Oral Slope Factor (kg day/mg)	Source	Chronic Inhalation Reference Dose (mg/kg day)	Source	Inhalation Slope Factor (kg day/mg)	Source
Acetone	1.0 E-1	I 1/92	#N/A	I 1/92	#N/A	H 3/92	#N/A	I 1/92
2-Butanone	5.0 E-2	H 3/92	#N/A	I 12/92	3.0 E-1	I 12/92	#N/A	I 12/92
Carbon tetrachloride	7.0 E-4	I 10/92	1.3 E-1	I 10/92	#N/A		5.3 E-2	H92
Chloroform	1.0 E-2	I 7/92	6.1 E-3	I 7/92	#N/A		8.1 E-2	H92
1,1-Dichloroethane	1.0 E-1	H92	#N/A		1.43 E-1	H92*	#N/A	
1,1-Dichloroethylene	9.0 E-3	I 1/92	6.0 E-1	I 1/92	#N/A		1.75 E-1	I 1/92*
1,2-Dichloroethene	9.0 E-3	H 11/92	#N/A	H 11/92	#N/A	H 11/92	#N/A	H 11/92
Methylene Chloride	6.0 E-2	I 1/92	7.5 E-3	I 1/92	9.0 E-1	H 3/92	#N/A	I 1/92
4-Methyl-2-pentanone	5.0 E-2	H92#	#N/A		2.0 E-2	H92	#N/A	
Tetrachloroethene	1.0 E-2	I 4/92	5.2 E-2	E 8/92	#N/A	H 3/92	2.0 E-3	E 8/92
Toluene	2.0 E-1	I 8/92	#N/A	I 8/92	1.0 E-1	I 8/92	#N/A	I 8/92
1,1,1-Trichloroethane	9.0 E-2	H92#	#N/A	I 1/92	3.0 E-1	H92	#N/A	I 1/92
Trichloroethene	6.0 E-3	E 8/92	1.1 E-2	E 8/92	#N/A	H 3/92	6.0 E-3	E 8/92
Xylene, total	2.0 E+0	I 1/92	#N/A	I 1/92	#N/A	H 3/92	#N/A	I 1/92
Aluminum	#N/A		#N/A		#N/A		#N/A	
Antimony	4.0 E-4	I 3/91	#N/A		#N/A		#N/A	
Arsenic	3.0 E-4	I 10/92	1.8 E+0	E 8/91	#N/A	H 3/92	5.0 E+1	H 3/92
Barium	7.0 E-2	I 1/92	#N/A	E 8/91	1.0 E-4	H 3/92	#N/A	E 8/91
Beryllium	5.0 E-3	I 1/92	4.3 E+0	I 1/92	#N/A		8.4 E+0	H92*
Cadmium	5.0 E-4	I 6/92(water)	#N/A	ID-H	#N/A		6.1 E+0	H92*
Calcium	#N/A		#N/A		#N/A		#N/A	
Chromium, VI	5.0 E-3	I 4/92	#N/A		5.71 E-7	H91*	4.1 E+1	H92
Cobalt	1.0 E-5	E 7/91	#N/A		#N/A		#N/A	
Copper	3.71 E-2	H92@	#N/A	I 1/92	#N/A		#N/A	I 1/92
Cyanide	2.0 E-2	I 1/92	#N/A	I 2/93	#N/A	H 3/92	#N/A	I 2/93
Iron	#N/A		#N/A		#N/A		#N/A	
Lead	#N/A	I 5/91	#N/A	I 5/91	#N/A	I 5/91	#N/A	I 5/91
Magnesium	#N/A		#N/A		#N/A		#N/A	
Manganese	5.0 E-3	I 1/93(water)	#N/A	I 1/93	1.1 E-4	I 1/93*	#N/A	I 1/93
Mercury	3.0 E-4	H92	#N/A	I 1/92	9.0 E-5	H92	#N/A	I 1/92
Nickel	2.0 E-2	I 1/92	#N/A		#N/A		8.4 E-1	H92
Potassium	#N/A		#N/A		#N/A		#N/A	
Selenium	5.0 E-3	I 6/91	#N/A	I 6/91	#N/A		#N/A	I 6/91
Silver	5.0 E-3	I 1/92	#N/A	I 1/92	#N/A		#N/A	I 1/92
Sodium	#N/A		#N/A		#N/A		#N/A	
Thallium	7.0 E-5	H 91	#N/A	D-I 1/92	#N/A	I 1/92	#N/A	D-I 1/92
Tin	6.0 E-1	H92	#N/A		#N/A		#N/A	
Vanadium	7.0 E-3	H92	#N/A		#N/A		#N/A	
Zinc	3.0 E-1	I 10/92	#N/A	I 10/92	#N/A	H92	#N/A	I 10/92

#N/A = Not available

* = calculated from unit dose

#=removed on IRIS

@=calculated from concentration

H = Health Effects Assessment Summary Tables, U.S. EPA, FY1991.

I = Integrated Risk Information System, U.S. EPA on-line database (document date noted).